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SAUER (H. F. G.). **Biologia de** *Calliephialtes dimorphus* **Cushm. (Hym. Ichn.) um interessante parasita primario de** *Platyedra gossypiella* **(Saunders).** [The Biology of *Ephialtes dimorphus*, an interesting primary Parasite of *P. gossypiella*.]—*Arq. Inst. biol.* **10** pp. 165–192, 7 figs., 1 pl. S. Paulo, 1939. (With a Summary in English.)

Laboratory investigations were carried out at Campinas, São Paulo, in 1938–39 on the bionomics of *Ephialtes* (*Calliephialtes*) *dimorphus*, Cushm. [*cf. R.A.E.*, A **28** 10], which is widely distributed in southern Brazil and parasitises *Platyedra gossypiella*, Saund., on cotton and *Myelois decolor*, Zell., on coffee. Descriptions are given of all stages of this Ichneumonid, the technique by which it was bred, the processes of pairing, oviposition and pupation, and the way in which the females feed on the host larvae. The host used in the laboratory was *P. gossypiella*; investigations on alternative hosts showed that although females oviposited on the larvae of several species, the only one on which the parasite was able to complete its development was the Pyralid, *Leucinodes elegantalis*, Gn.

Males were somewhat more numerous than females in the field and in the laboratory. Adult longevity varied considerably even under identical conditions of temperature and food, but was in the main dependent on temperature; it was considerably reduced above 23°C. [73·4°F.]. Of females kept at an average temperature of 18·4°C. [65·12°F.] and provided with various combinations of food, those given water, concentrated sugar solution and host larvae survived the longest (average 48·4 days); the average longevity of males under similar conditions was 22 days. Pairing, which sometimes took place immediately after emergence and sometimes repeatedly, occurred under very varied conditions and at all temperatures between 17 and 30°C. [62·6 and 86°F.]. The interval between pairing and oviposition varied between 6 and 19 days and averaged 14·6. Females oviposited at temperatures between 20 and 30°C. [68 and 86°F.] and normally laid one egg on or near each host. In the insectary as many as 8 were laid on a single host, but of these only one gave rise to an adult. The duration of the oviposition period varied from 14 to 101 days, with an average of 31·6, and females deposited 14–369 eggs, with an average of 100·7, at the average rate of 3·18 per day. Unfertilised females oviposited, giving rise to males only.

The duration of the egg stage at different times of the year averaged 2 days; it varied very little at temperatures between 18·8 and 25°C. [65·84 and 77°F.]. On hatching, the larvae attach themselves to the hosts and feed on the body contents. They did not survive long without food. They fed on the host for an average of about 6 days, leaving only the integument, and then entered a resting stage during which they spun cocoons. The complete larval, prepupal and pupal stages averaged 12·4, 2·6 and 9·5 days, respectively. The duration of the life-cycle from egg to adult depended largely on temperature; at 24°C. [75°F.] it was about 18 days, and was somewhat longer for females than for males. In the insectary, where breeding was continuous, 8 generations were obtained in a year, but only 4 were observed in the field. Females feed on the host larvae throughout their life and kill an average of 3–5 a day. The males sometimes feed on the remains of larvae left by the females. The ovipositor of the female is very long, but as it is unable to pierce resistant surfaces,

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it is able to reach the host only through an aperture. The adults appear in the cotton fields during May and are most abundant in August and September, when the cotton bolls have opened and afford access to the host larvae, which at that time are mostly hibernating. No parasites were observed in the field in summer ; laboratory experiments showed that this was not due to a diapause.

In a brief discussion of the importance of *E. dimorphus* in the control of *P. gossypiella*, it is stated that the average percentage parasitism by it in cotton fields at Campinas in the period April–November 1938 reached its maximum (3·85) in October. Its efficiency is limited by the practice of rooting out and burning the remains of the cotton crop at the time of its greatest activity and by its apparent absence from cotton fields during the summer. It is also destroyed in coffee plantations by the methods adopted against *Stephanoderes hampei*, Ferr.

SAUER (H. F. G.). **Notas sobre *Elasmopalpus lignosellus* Zeller (Lep. Pyr.), séria praga dos cereais no estado de São Paulo.** [Notes on *E. lignosellus*, a serious Pest of Cereals in S. Paulo.]—*Arq. Inst. biol.* **10** pp. 199–206, 2 pls. S. Paulo, 1939. (With a Summary in English.)

In Brazil, *Elasmopalpus lignosellus*, Zell., attacks chiefly grasses and leguminous plants, its cultivated food-plants including maize, rice and beans. In November 1938, a severe infestation of upland (dry-cultivated) rice occurred in the State of São Paulo, where the population of this Pyralid had been increasing for about four years. Collections at light in Campinas showed that the adults are present from late August until late April. The egg stage lasted 5 days in December. In the laboratory, newly hatched larvae fed on rice leaves, but almost all of them died in the first instar and the remainder in the second. Older larvae collected in the field in November fed for 8–15 days on young rice plants and gave rise to adults in December. Rice was most severely attacked in the field between 15th and 25th November, when the plants were about 5 ins. high. By mid-December, larvae were rare and only the most backward plants were attacked. The larvae bored into the plants at or just below the surface of the ground, up to 4 plants being destroyed by single larvae. In some fields the injury was uniform, while in others it was patchy. The infestation appeared to be more severe in sandy soil than in more compact ground, and plants advanced in growth were very rarely attacked. No effective direct measures against *E. lignosellus* are known ; experience has shown that the best control is given by crop rotation, ploughing after the harvest, and keeping the ground in and round the fields free from grasses or leguminous plants. It was observed in São Paulo that the infestation of rice was greatest in fields sown in the first 10 days of October, and decreased in proportion as sowing was delayed. The date cannot be much varied in practice, as it is dependent on the rains, but postponement at least until mid-October should be possible.

MALTAIS (J. B.). **The Use of a Bamboo Pole Drag in enhancing the Value of Dusts in the Control of the Pea Aphid.**—*Canad. Ent.* **71** no. 11 pp. 240–241, 1 fig. Guelph, 1939.

During a severe infestation of peas by the pea aphis [*Macrosiphum onobrychis*, Boy.] in Quebec in 1938, it was observed that although the

equipment and quantity of rotenone dust employed for control were considered to be adequate, a large proportion of the Aphids were not dislodged, especially from short-stemmed peas, and many were still alive a week after treatment. This difficulty was overcome by fixing to the distribution boom of the dusting equipment three drags, corresponding in length to each of the three sections of the boom. Each drag consisted of three bamboo rods fastened behind each other by small ropes so that a space of about 1 ft. was left between them. The drags extended approximately 4 ft. over all behind the boom under the light canvas apron used during the dusting. They dislodged the Aphids from the terminal clusters, so exposing them to the dust ; immediately after treatment, the plants were free from infestation, and the ground beneath them was covered with partly paralysed Aphids. The plants were not injured by the drags.

MORLEY (P. M.). **Time of Cut as a Factor influencing Infestation of Coniferous Logs.**—*Canad. Ent.* **71** no. 11 pp. 243–248, 2 refs. Guelph, 1939.

Dead and weakened trees and logs left in the forest are subject to attack during the summer by a number of insects, as a result of which the value of the timber is reduced, and in some cases the insects may become so numerous that the living stand is attacked. The extent to which infestation by 18 Coleoptera and *Sirex cyaneus*, F., which are grouped according to their feeding habits, is affected by the time of cut was investigated in eastern Canada, where logs of pines, spruces and balsam fir [*Abies balsamea*] that were cut at fortnightly intervals between October 1936 and September 1937 and placed in such a manner that each log was individually exposed on low racks that cleared the ground were examined in September 1937 and again in August 1938. Tables show for pine, spruce and balsam fir, respectively, the months in which the logs were felled and the stages of the various pests found in them at each examination, and notes are given on the exit holes.

The following is based on the author's discussion : There is a definite relation between infestation and the time of cut. The flight period of each species differs both in time of occurrence and in duration ; furthermore, the food preference for logs at different stages in the seasoning process varies from species to species, and it is therefore possible to deduce from the nature of the insect attack the time of year at which the log was cut. Most bark-beetles generally prefer freshly cut logs, but *Ips* (*Orthotomicus*) *caelatus*, Eichh., which attacks both pine and spruce, does not. The ambrosia beetles (*Gnathotrichus materiarius*, Fitch, in pine and spruce, and *Trypodendron lineatum*, Ol. (*bivittatum*, Kby.) in pine, spruce and balsam fir) appear early in the spring and prefer the slightly seasoned logs cut in late summer and autumn. It is suggested that, within the limits of seasoning, the moisture content of the logs is probably a determining factor, since the damp condition and heavy blue stain of logs cut in August were particularly noticeable in the second season after felling. The Lamiids, *Monochamus scutellatus*, Say, *M. notatus*, Dru., and *M. titillator*, F., which are considered to be the most destructive pests of unseasoned coniferous logs in eastern Canada, are not affected by time of felling and will readily attack logs cut at all seasons. Logs cut in late summer and autumn are not attacked by sap-wood borers (*Sirex* and *Serropalpus*).

Life History of the Codling Moth (*Carpocapsa pomonella*) **in Palestine.**—*Mon. agric. Bull. Palestine* October 1939 pp. 2–4. Jerusalem, 1939.

Notes are given on the economic importance of *Cydia* (*Carpocapsa*) *pomonella*, L., and on its bionomics and control in Palestine, where it attacks various deciduous fruits [*cf. R.A.E.*, A **26** 500]. There are usually five overlapping generations during the year, and all stages are present throughout the season. Adults of the overwintering generation appear in two flights, one at the beginning and the other in the middle of April, and subsequent generations are completed in an average period of 33 days. Observations showed that both in the inner plains and on the coast of Palestine, the larvae that hibernate belong exclusively to the fourth or fifth generations.

In experiments on control, in which lead arsenate sprays were compared with dusts of calcium arsenate and barium or sodium fluosilicate, the best results were given by a spray of lead arsenate when 75 per cent. of the petals had fallen, followed by dusting with barium fluosilicate at intervals of 2–3 weeks. In plots treated with lead arsenate the losses averaged 20–25 per cent., as compared with 55–60 in untreated plots. Dusting with calcium arsenate was ineffective.

Deciduous fruit trees should also be sprayed against *Ceratitis capitata*, Wied., which attacks them almost at the same time as *Cydia* and particularly from mid-May to mid-June, during the whole of July, and from mid-September to mid-October [*cf.* **28** 270]. The formula recommended against both pests is 10 lb. lead arsenate, 2·7 lb. copper carbonate, 35 lb. sugar and 8 oz. Agral spreader in 100 gals. water, and the spray should be applied at intervals of 2 weeks at the beginning of the season and 10 days during the peaks of activity of the fly.

Lever (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **10** no. 4 pp. 125–126, 5 refs. Suva, 1939.

In Fiji, the leaves of ornamental *Eranthemum* are attacked every year, and particularly in February–March and June–September, by the larvae of *Doleschallia australis*, Fldr. In February and March 1939, adults of the Ceratopogonid, *Forcipomyia hirtipes*, de Meij., were observed near Suva attacking nearly full-grown larvae of this Nymphalid, but the latter were not apparently affected and pupated normally.

Following information from Tonga that *Teleonemia scrupulosa*, Stål (*lantanae*, Dist.), which was introduced there from Fiji in 1937 for the control of *Lantana* [*cf. R.A.E.*, A **27** 212], had failed to become established, a fresh consignment of the Tingid was forwarded on 11th July. As direct transport was available, the consignment reached Tonga in 3 days, as compared with 3 weeks by the normal route *via* New Zealand, and in excellent condition. In the course of work on the bionomics of *Teleonemia*, it was observed that eggs were deposited in the tissue of the outer edge of the leaf away from the veins, in which they are normally embedded [*cf.* **17** 564 ; **26** 86]. The author cites C. J. Drake as the authority for considering *T. lantanae* a synonym of *T. scrupulosa*.

A mite, identified by H. Womersley as *Caloglyphus mycophagus*, Mégn. [*cf.* **26** 94] was found infesting mouldy copra of poor quality on Ovalau. It is considered that it would not infest good quality copra stored under clean conditions and away from rice.

CARTER (Walter). **Populations of *Thrips tabaci*, with special Reference to Virus Transmission.**—*J. Anim. Ecol.* **8** no. 2 pp. 261–276, 1 pl., 4 figs., 5 refs. London, 1939.

The following is substantially the author's summary: Populations of *Thrips tabaci*, Lind., the vector of yellow spot disease of pineapple, on *Emilia sonchifolia*, which is an important reservoir of the virus and has previously been misidentified as *E. sagittata* [*R.A.E.*, A **24** 504, etc.] were recorded in 1934–35 in four localities on the Island of Oahu, Territory of Hawaii. The population densities varied widely, but the seasonal trends were the same at all four points, with decidedly lower populations in the winter months. The percentage of disease in *Emilia* followed closely the percentage of infested plants, indicating that once a colony of *T. tabaci* is established on *Emilia* there is little movement from it. The populations were on the whole higher on diseased than on healthy plants.

Data on the wind dispersal of a number of species of thrips recorded at one of the localities indicated that *T. tabaci* is not a migratory species. Most of the species trapped attained their greatest incidence and numbers during the autumn and winter months. Incidence of yellow spot disease in pineapple is not correlated with the density of the population of *T. tabaci* on *Emilia* in neighbouring areas. This is accounted for on the grounds that *Emilia* is a preferred food-plant from which dispersal does not normally occur. The cultivation of food-plant areas and drought are two possible factors affecting dispersal.

ROBERTSON (A. G.). **The nocturnal Activity of Crane-flies (Tipulinae) as indicated by Captures in a Light-trap at Rothamsted.**—*J. Anim. Ecol.* **8** no. 2 pp. 300–322, 1 pl., 8 figs., 6 refs. London, 1939.

The following is based on the author's summary of this paper, in which he states that the Tipulids of economic importance in England are *Tipula paludosa*, Mg., *T. oleracea*, L., and *Pales flavescens*, L.: During the four years 1933–36, 3,394 adults of 17 species of Tipulids were taken in a light-trap at Rothamsted Experimental Station [*cf. R.A.E.*, A **27** 95]. By far the commonest species was *T. paludosa*, which comprised 57·4 per cent. of the total; *P. flavescens* and *T. oleracea* comprised 6·7 and 3·3 per cent., respectively, and 10 other species together only 1 per cent. In general, males were attracted to light in greater numbers than females; species in which this was the case included *T. paludosa* and *P. flavescens*, but females predominated in *T. oleracea*.

The greatest activity was recorded in September and was due to *T. paludosa*, and a minor peak occurred in June as a result of the activity of *P. flavescens*; July was a month of reduced activity. There appear to be two generations a year of *T. oleracea* and possibly of *T. paludosa*, but the other five commoner species have only one. Activity is greatest immediately after sunset and is maintained at a maximum rather longer in males than in females. There is a slight secondary maximum near midnight, except in *T. paludosa*, in which activity increases towards dawn. High minimum temperatures and small differences between the daily maxima and minima favour activity, which is little affected by changes in maximum temperature so far as these are independent of minimum temperature. During the period of greatest activity, a rise in the minimum temperature of 4–4½°F.,

or a reduction in the daily range of temperature of about 6°F., doubled the number of Tipulids trapped. Most were taken on moonless nights, when they were rather more than twice as numerous as on nights of full moon, and on cloudy nights, when, chiefly owing to the higher minimum temperature, they were three times as numerous as on clear nights.

The Douglas Fir Tussock Moth as a Shade Tree Pest.—1 p. multigraph. Ottawa, Publ. Ext. Div. Dep. Agric., 1939.

Though chiefly of importance as a forest pest [*cf. R.A.E.*, A **21** 69], the Douglas-fir tussock moth [*Hemerocampa pseudotsugata*, McDunn.] has caused serious damage to Douglas firs [*Pseudotsuga taxifolia*] growing as shade trees round farm houses in British Columbia. Trees near buildings seem to be particularly liable to severe infestation, possibly because the eaves offer a good shelter for pupation [*cf.* **26** 293]. For control, a spray of 1 lb. lead arsenate in 10 gals. water with a suitable spreader is recommended; it should be applied 1–3 weeks after the larvae hatch in spring.

High (M. M.). **The Vegetable Weevil.**—*Circ. U.S. Dep. Agric.* no. 530, 25 pp., 12 figs., 18 refs. Washington, D.C., 1939.

An account is given of the results of investigations, carried out in southern Mississippi in 1934–36, on the habits and control of *Listroderes obliquus*, Klug, which was first observed in the United States in 1922 and is becoming an increasingly serious pest of vegetables. This weevil, which is polyphagous and easily adapts itself to new environments, occurs in large sections of Louisiana, Mississippi and Alabama, and in smaller adjoining areas in the surrounding States, as well as in California [*cf. R.A.E.*, A **21** 168, etc.]. Descriptions are given of all stages and its distribution in the United States and elsewhere, with lists of its food-plants, which include most of the important vegetables, a few cultivated flowering plants and a large number of weeds.

L. obliquus has only one generation a year in the Gulf Coast States. The periods of occurrence of the stages are influenced by climatic conditions, but in normal years eggs can be found from late September to late April, larvae from late October to mid-May, and pupae from mid-November to mid-June. The adults emerge from December to June and occur throughout the year, though they aestivate in hot weather (June–September).

Immediately after hatching, the larvae feed on the buds and the lower surfaces of the leaves close to the buds, and later attack all foliage, and the roots of such crops as carrots and turnips. The adults feed usually at night and mainly on leaves, but sometimes also on roots of carrots and turnips. In the spring they feed on the leaves of small tomato and potato plants and cut off the stems at ground level. No males of *L. obliquus* have been observed in the area under investigation, and reproduction is parthenogenetic. Characters are given distinguishing this weevil from *L. apicalis*, Waterh., with which it is sometimes confused and which also attacks vegetables, but in which both sexes are represented.

In studies on the life-history of *L. obliquus*, made from 1925 to 1933, larvae were collected in the field and the resulting pupae were isolated in small tin boxes partly filled with soil. The adults were fed on

turnips and carrots throughout the spring and summer, and early in the autumn, when they resumed active feeding, they were transferred to fresh boxes partly filled with soil or sand. During the oviposition period, each weevil was transferred daily to a new container and supplied with fresh food. They oviposited in the turnips and carrots on which they were fed. The rate of development of all stages was dependent on temperature. During the spring and autumn the egg stage usually lasted 15–20 days. The larval stage lasted 23–45 and averaged 38 days, including a prepupal stage ranging from 1–2 to 14 or more days, and the pupal stage lasted 13–41 days. The prepupal and pupal stages are passed in cells in the soil near the food-plant. The depth at which they occur varies with the texture and moisture content of the soil; it was usually $\frac{1}{2}$ to 2 ins., but in dry cracked soil was as much as 6–9 ins. The adult remains in the pupal cell for a few days.

The newly emerged weevils feed voraciously before aestivation. When adults were confined without food the majority lived for 70–90 days, while 8 per cent. were alive after 266 days and one individual survived for 310 days. The weevils aestivate in convenient shelter, such as that provided by dead grass, straw, rubbish or the loose bark of trees. The rate of mortality during this period, which ranged from 40 to 90 per cent. in cages, could not be determined under field conditions, but large numbers of dead weevils were found in typical aestivating quarters late in the summer. Weevils emerging during the winter or spring do not oviposit until the following autumn or winter. At the end of their summer inactivity they feed for a time before beginning to oviposit; the complete pre-oviposition period therefore ranges from 6 to 8 months. Eggs are deposited singly or in small groups on plants and on or in the soil nearby. The crowns of plants are usually preferred when ample moisture is present. The oviposition period of 29 weevils in cages ranged from 63 to 395 days. The adults usually live for about a year, but weather conditions and food-supply cause considerable variation, excessive moisture or high temperatures and absence of moisture being unfavourable. The maximum longevity recorded was 23 months.

All stages of the weevil can survive relatively low temperatures; living larvae, pupae, and adults were found in the field after a period of frost lasting for 29 days and also two days after a minimum temperature of 18°F. had been recorded. Infestation in the Gulf States has spread inland at the rate of about 50 miles a year. Dispersal has been more rapid in open cultivated land than in wooded areas, which suggests that it is effected by flight as well as by transport of infested vegetables. The weevils have been observed to fly, but only when they were exposed to the sun either in cages or on high objects in the field. They could never be induced to fly when wind was blowing.

Natural enemies of *L. obliquus* include spiders, ants of the genus *Solenopsis* and various wild birds, but they are not of great importance. Fowls have proved efficient in clearing up small infestations. Clean cultivation and rotation of crops are important in reducing damage by this pest, and insecticides are of value on crop remnants or crops on which the residue is not likely to be dangerous [*cf.* **27** 372]. In late winter and early spring, large numbers of newly emerged weevils can be destroyed by poisoned baits, of which the most effective consisted of 1 lb. sodium fluoride, 1 lb. dehydrated carrots or turnips (or 8 lb. fresh

finely chopped carrots or turnips), and 15 lb. wheat bran with sufficient water to form a mash. The bait is more attractive if allowed to stand several hours before it is applied. To prevent its becoming too dry, it should be scattered late in the afternoon. From 60 to 100 lb. per acre is necessary.

THOMPSON (W. L.). **Notes on *Chaetoanaphothrips orchidii* (Moulton) found attacking Citrus Fruit in Florida.**—*Florida Ent.* **22** no. 4 pp. 65–67, 1 ref. Gainesville, Fla., 1939.

In 1937, grapefruits attacked by nymphs of a thrips in a grove on Merritt Island, Florida, exhibited unusual surface markings, and an adult thrips, later identified as *Anaphothrips* (*Chaetanaphothrips*) *orchidii*, Moult., was collected in December on a marked fruit in the grove. Similar injury was recently observed by A. M. Boyce on oranges in California and by the author in 1938 on grapefruits in Honduras. In both these cases, it was due to *Heliothrips haemorrhoidalis*, Bch., and excreta were present on marked fruits. No excreta could be seen on the fruits in Florida. Investigations in 1938 showed that *A. orchidii* was more abundant in a neglected grove than in one sprayed regularly for disease and insect control. In the latter, with the exception of one oil treatment, all sprays contained sulphur. In 1939, *A. orchidii* was taken on grapefruits, oranges and tangelos in seven counties in central Florida, and a few examples of *H. haemorrhoidalis* were also found in the groves in two counties.

Brief descriptions are given of the adult and nymph of *A. orchidii*. Young nymphs were observed 10 days after adults had been placed on the fruit, and in 33 days (30th September to 2nd November) adults were observed. Usually 4–6 nymphs infest one fruit, but as many as 16 nymphs and 4 adults have been found on a single fruit. They feed in sheltered areas and occur chiefly at the points where fruits come into contact with leaves or with each other; green immature fruits are preferred. Injury to young fruit appears as a solid area, and as the fruit matures it becomes a silvery to dark brown blotch, 2–3 inches wide. Injury to mature fruit appears as a dark brown ring. Such ringed injury on grapefruits has been observed for some years and was thought to be the result of oil being pressed out of the rind by the weight and rubbing of large fruits hanging in clusters. Commercial damage was limited to groves in which no sulphur, or only a minimum number of sulphur sprays, had been applied during spring and summer. In an unsprayed plot in a commercial grove, the thrips caused injury to 57 per cent. of fruits hanging singly and 70 per cent. of those in clusters. The thrips population is apparently kept at a minimum by the sulphur sprays [*R.A.E.*, A **27** 256] applied for the control of the rust mite [*Phyllocoptruta oleivorus*, Ashm.]. In a preliminary experiment, a single application of 1·5 per cent. lime-sulphur with 6 lb. wettable sulphur per 100 U.S. gals. decreased the thrips population on grapefruit by 84 per cent.

CHANDLER (S. C.) & FLINT (W. P.). **Controlling Peach Insects in Illinois.**—*Circ. Ill. nat. Hist. Surv. Div.* no. 33, 40 pp., 32 figs., 7 refs. Urbana, Ill., 1939.

In this circular, accounts are given of the bionomics and control of the insects that attack peach in Illinois and of the type of injury

that they cause. In addition to the tree borers [*R.A.E.*, A **27** 526], they include *Aspidiotus perniciosus*, Comst., *Cydia* (*Grapholitha*) *molesta*, Busck, and *Conotrachelus nenuphar*, Hbst., which are dealt with in some detail, and *Lecanium nigrofasciatum*, Perg., *Anarsia lineatella*, Zell., *Lygus pratensis*, L., *Euschistus* spp., *Popillia japonica*, Newm., *Cotinis nitida*, L., and *Alabama argillacea*, Hb. The adults of *Popillia* and *Cotinis* feed on the ripening fruits and those of *Alabama* puncture the ripe ones, which often rot in consequence. This Noctuid is the only fruit-piercing moth found in Illinois ; it migrates into the State from the south and cannot overwinter there.

Knowlton (G. F.). **Grasshopper Control in Utah—1938.**—*Proc. Utah Acad. Sci.* **16** pp. 43–47, 1 map, 1 ref. Provo, Utah, 1939.

In 1938, an extensive campaign had to be carried out against grasshoppers in Utah. *Melanoplus femur-rubrum*, DeG., *M. mexicanus*, Sauss., and *M. packardi*, Scudd., were the most widely distributed and injurious of the species, which also included *M. bivittatus*, Say, and *Camnula pellucida*, Scudd. Hatching began about mid-April, and owing to a cold late spring, it continued for several weeks. The application of baits began on 1st June and had to be continued in some areas until mid-September ; 34 bait-mixing stations were opened and 405 tons of dry material were used. The bait consisted of 400 lb. bran, 2 U.S. gals. sodium arsenite and 35–45 U.S. gals. water. The bran was sometimes mixed with varying quantities of sawdust to improve its spreading quality, particularly when it was fine or contained a large amount of shorts. The addition of amyl acetate or molasses did not perceptibly alter the efficiency of the bait. In most cases, the regular application of baits successfully protected the crops, in spite of the prolonged hatching and local migrations of the grasshoppers. The value of the crops lost was estimated at $650,000 and that of the crops saved at over $1,000,000. The numbers of grasshoppers were noticeably reduced in some areas by turkeys, fowls and wild birds, Sarcophagid parasites, particularly *Sarcophaga kellyi*, Aldr., fungi and possibly bacteria.

Fox (H.). *Schistocerca americana* (**Drury**) **unusually abundant in southern New Jersey during the Autumn of 1939 (Orthoptera : Acrididae).**—*Ent. News* **51** no. 2 pp. 43–45. Philadelphia, Pa, 1940.

As a rule, *Schistocerca americana*, Dru., of which *S. paranensis*, Burm., is probably the gregarious phase, is rare in southern New Jersey, but in October and November 1939 there was a phenomenal increase in its numbers throughout that area. The adults were particularly abundant on abandoned fields and on wood clearings overgrown by grasses (*Andropogon*) and bayberry bushes. Since no increase in the local population was previously observed, it appears probable that one or more swarms had invaded the State from the south.

Schiuma (R.). **Destrucción de " tucuras " con cebos tóxicos.**—14 pp., 5 figs. La Plata, Minist. Obr. publ. Prov. B. Aires, Direc. Agric. Ganad. Industr., 1940.

The standard poison bait recommended for use against grasshoppers in Argentina consists of 100 lb. bran, 7 gals. water and 2 lb. sodium

arsenite, with or without the addition of 1 gal. molasses. The best carrier is wheat bran, which should be clean and contain not more than 13 per cent. moisture, not less than 5·8 per cent. ash (dry weight), and 22·5 per cent. flour. In experiments, good results were also obtained with maize bran and chaff, but sawdust gave poor results. The addition of molasses increased the attractiveness of the bait, and although it is not indispensable, it should preferably not be omitted. The poison used contained 13 lb. arsenic, 7 lb. sodium hydroxide and $1\frac{1}{2}$ gals. water. Some experiments with cryolite gave good results, and its application might be considered. Dry baits prepared for distribution to farmers retained their effectiveness after being kept for three months. The usual instructions are given for scattering the bait, including descriptions of mechanical spreaders and precautions against poisoning.

Wood (J.). **Some common Pests of ploughed-up Grassland.**—*Kirton agric. J.* no. 4 pp. 22–25. Boston, 1939.

Brief popular notes are given on the life-history of wireworms, cutworms, Tipulids and slugs, all of which are usually present in fairly large numbers in grassland in England and may become important pests of crops when this land is broken up for cultivation. To reduce injury by wireworms in ploughed pastureland, the turf should be buried deeply so as to attract the larvae while the new crop is being established; the most suitable crop for the first year is potatoes [*cf. R.A.E.*, A **28** 157]. To prevent attack late in the season, it is advisable to lift the crop early, and a late crop of mustard should then be sown as a source of green manure to attract the larvae in the following season [**27** 97]. If potatoes are planted again in the second year, naphthalene should be applied at the rate of 3 cwt. per acre in the rows at planting time. For general application, drained creosote salts can be ploughed in at the rate of 8 cwt. per acre to a depth of 8 ins., but this should be done at least 14 days before the potatoes are planted, as otherwise it may damage them. Naphthalene, whether in its crude form as creosote salts or in a more refined form, acts chiefly as a repellent. Repeated applications are likely to decrease in effectiveness; and it does not safeguard the potato crop from attack late in the season.

Tipulid larvae, which cause most injury to crops following grass or clover leys, and cutworms can be controlled by broadcasting thinly over the soil in the evening a poison bait consisting of 1 lb. Paris green, 28 lb. bran and 1 gal. water, which suffices to treat an acre. The poison and the bran should be thoroughly mixed and the water then added in small quantities; the bait should be moist, but not wet.

Roland (G.). **Bijdrage tot de kennis der virusziekten van de spinazie. (Contribution à l'etude des maladies à virus de l'épinard.)**—*Tijdschr. PlZiekt.* **45** pt. 6 pp. 260–274, 2 pls., 15 refs. Wageningen, 1939. (With a Summary in French.)

In March 1938, diseased spinach plants were received for investigation from Maastricht, where growers stated that less than half the winter spinach was living in most fields and many of the plants still alive were unsaleable. The symptoms in the less severely affected plants were similar to those that occur in spinach infected

with the virus yellows of beet [*cf. R.A.E.*, A **24** 405], first appearing in the outer leaves, but experiments showed that another virus was also present in the more severely affected ones. Chemical analysis of diseased leaves indicated that this virus was not identical with the virus of cucumber mosaic, which causes spinach blight [*cf.* **21** 536, etc.], but the disease was apparently of the mosaic type, as healthy spinach plants inoculated with sap from diseased ones first showed symptoms of discoloration in the youngest leaves and subsequently yellowing of the older ones, and sap from one of them produced similar symptoms in other spinach plants. Symptoms of mosaic were produced in beet by inoculation of sap from diseased spinach, with a minimum incubation period of 13 days, and, unlike spinach blight, symptoms of the systemic infection type were observed. In further inoculation tests, the symptoms were also produced in cucumber, tobacco (*Nicotiana tabacum*) and *N. glutinosa*, but not in beans, tomato, *Datura stramonium*, *Chenopodium album*, *Atriplex* spp., or *Amarantus retroflexus*.

Some investigations were carried out on transmission by means of *Myzus persicae*, Sulz. When Aphids from diseased spinach were transferred to healthy spinach, symptoms of mosaic were produced on the young leaves and of yellows on the outside leaves, and the Aphid also transmitted yellows from spinach to beet. Similar results were obtained in experiments with diseased spinach plants from the Hague, and it is concluded that they were infected with the same two virus diseases as those from Maastricht.

In comparative tests, the mosaic disease produced in beet by inoculation showed symptoms that differed from those of the usual mosaic of beet, and the two viruses differed in their reactions to heat. Similar symptoms were produced, however, in cucumbers and plants of *N. glutinosa* inoculated with sap from diseased spinach and from cucumber leaves infected with cucumber virus 1.

It is concluded that the spinach was infected with two virus diseases, of which one was the virus yellows of beet, which was transmitted only by the Aphid, and the other a mosaic disease transmissible by the Aphid and by sap inoculation, for which the name spinach mosaic is proposed. The latter differed from beet mosaic, and although it also differed in some respects from spinach blight, it resembled it in others. It is therefore considered to be a variety of cucumber virus 1. Spinach mosaic appeared to be less dangerous to beet than virus yellows, for when an infected spinach plant bearing numerous examples of *M. persicae* was planted in mid-June in the middle of a field of beet, none of the neighbouring beet plants developed symptoms. The best methods of control are late sowing, the use of varieties of spinach that are resistant to cold, and late thinning of winter spinach.

Feytaud (J.) & de Lapparent (P.). **Remarques sur la composition et sur la durée d'action des poudres roténonées.**—*C. R. Acad. Agric. Fr.* **25** no. 26 pp. 1039–1044, 4 refs. Paris, 1939.

Experiments were carried out in France in 1938 to compare the insecticidal value of a cubé dust (6 per cent. rotenone content) used alone or in combination with various diluents, each mixture containing 15 per cent. cubé. Fourth-instar larvae of the potato beetle [*Leptinotarsa decemlineata*, Say] were used as the test insects. The results showed that the mixtures were practically as toxic as the pure cubé,

which caused fatal paralysis of the larvae in less than 2 hours, and that calcium carbonate, sulphur, kaolin, carbonated talc or gypsum were preferable to silica, bentonite or, particularly, lime.

To test the durability of the dusts, they were kept in closed metal boxes for 3 and 13 months or exposed in layers of 2–3 mm. to light and changes in temperature and humidity in an insectary for 3, 5 and 15 months. There was no decrease in the toxicity of the dusts kept in metal boxes, with the exception of the mixtures containing bentonite and lime, of which the toxic action on the larvae was delayed for several hours. Of the dusts exposed in the insectary, cubé alone and mixtures of it with calcium carbonate, talc, sulphur, carbonated talc or gypsum retained their full toxicity even after 15 months, whereas the paralysing effect on the larvae of the dusts containing kaolin and silica was delayed for several hours, and that of the lime mixture for several days. The bentonite mixture showed a very retarded action after exposures of 3 and 5 months, and after 15 months it turned into a solid mass and when broken up did not affect the larvae placed on it.

In experiments in May 1939, a potato plant protected from rain but not from air, light or humidity was dusted with a mixture of derris and talc containing 0·25 per cent. rotenone, and larvae of *L. decemlineata* were placed on it on the same day or at various intervals. All those placed on it 27 days later, the longest interval tested, died within 24 hours. In further tests in June 1939, a commercially prepared dust containing 0·65 per cent. rotenone and stated to be stabilised against the effects of air and bright light was found to be considerably slower in its action than a non-stabilised dust of only 0·3 per cent. rotenone content, whether used after having been kept in an air-tight box or after exposure for nine days to bright sunlight. The addition of a colouring agent to the second dust did not increase its toxicity.

NICOLAS (G.). **Sur l'extension de** *Diaspis pentagona* **Targ. en France.**—*C. R. Acad. Agric. Fr.* **25** no. 26 pp. 1120–1121. Paris, 1939.

Aulacaspis (*Diaspis*) *pentagona*, Targ., appeared in France in 1913 near Mentone, and subsequently spread in Provence. Mulberry and peach are its preferred food-plants. It has also been observed in the region of Lyons, and was found in and near Toulouse in 1938 and 1939 on mulberry, *Platycarya strobilacea*, *Phellodendron japonicum*, and *Broussonetia papyrifera*.

VAYSSIÈRE (P.). **Au sujet de la dispersion du doryphore (Col.).**—*Bull. Soc. ent. Fr.* **44** no. 13–14 p. 178. Paris, 1939.

It appears certain that adults of *Leptinotarsa decemlineata*, Say, have sometimes been carried from place to place by rivers, and recent observations have shown that they can survive in the sea. In August 1938, adults covering some hundreds of square yards were observed in the English Channel ; they appeared to be swimming, and were not attacked by fish. In June 1939, adults were cast up along the coast of Brittany, and had been seen at sea attached to floating débris ; beetles collected on the beach were alive and later reproduced in the laboratory.

GRASSÉ (P. P.). **Les termites de l'île de Madère.**—*Bull. Soc. ent. Fr.* **44** no. 13–14 pp. 179–185, 18 figs., 5 refs. Paris, 1939.

The termites of Madeira comprise a species of *Reticulitermes* tentatively identified as *R. lucifugus*, Rossi, *Calotermes* (*Neotermes*) *praecox*, Hagen, and *C. barretoi*, sp. n., which is described from a soldier taken from a colony in a dead branch of chestnut. The soldier of the species of *Reticulitermes*, of which the author had no winged forms, differed in some characters from that of *R. lucifugus*, but these are not considered of specific value. Descriptions are given of the winged adult and the soldier of *C. praecox*, which has been found in various trees and bushes in the wooded zone of the north of the island at elevations of over 2,400 ft.

LEPESME (P.). **Note synonymique sur les** *Dermestes* **(Col.) et description d'une espèce et d'une variété nouvelles.**—*Bull. Soc. ent. Fr.* **44** no. 13–14 pp. 190–193. Paris, 1939.

Having examined the types of *Dermestes maculatus*, DeG., and *D. ater*, DeG., both of which were described in 1774, the author concludes that *D. vulpinus*, F., is a synonym of *D. maculatus*, and that *D. cadaverinus*, F., is a synonym of *D. ater*. *D. olivieri*, n. n., is proposed for *D. ater*, Ol. nec DeG.

MALENOTTI (E.). **Migrazioni superficiali notturne di larve sotterranee di Melolontidi.** [Nocturnal Migrations on the Surface of the Ground of subterranean Larvae of Melolonthids.]—*Atti Accad. Agric. Verona* (5) **18** repr. 5 pp., 3 pls. Verona, 1940.

Although information is available with respect to the horizontal and vertical migrations of Lamellicorn larvae in the soil [*R.A.E.*, A **27** 606], little is known about their movements on the surface. It was observed in Russia that the larvae of *Amphimallus solstitialis*, L., concentrated near the roots of seedlings [**26** 431], and investigations in Italy have shown that this is effected at night by surface movements. Fields near Verona in which red clover had been sown after wheat were infested in dry weather by the ant, *Messor barbarus*, L., which collected the seeds and stored them in heaps. Rain subsequently caused the seeds to germinate, and the resulting dense patches of clover attracted larvae of the genus *Amphimallus*. They pierced the surface of the ground with numerous exit holes, and in November were actually seen travelling on the surface by night, some covering 32 ins. in 40 minutes. Emergence from the ground began shortly after sunset and continued until about 10 p.m. No larvae emerged from ground that was wetted by rain. Starlings devoured large numbers of the larvae assembled at the clover.

CANZANELLI (A.). **Studio sul tonchio del fagiolo** (*Acanthoscelides obtectus* **Say).** [A Study on the Bean Bruchid, *Bruchus obtectus*, Say.]—*Boll. Zool. agrar. Bachic.* **9** pp. 1–45, 2 pls., 182 refs. Turin, 1940.

The author describes the morphology of all stages of *Bruchus* (*Acanthoscelides*) *obtectus*, Say, discusses from the literature the

synonymy, original habitat and present distribution of this Bruchid and the leguminous seeds [*cf. R.A.E.*, A **23** 534] that it attacks, and gives an account of observations on its bionomics in beans (*Phaseolus*) in north-central Italy [*cf.* **28** 107]. The data are compared with those recorded from Italy and elsewhere. Four generations were observed in the year, of which the first occurred in stored beans from late June to early August. Adults of this generation oviposited in mature beans in the field, and the resulting adults emerged in the storehouse. This generation occurred from late July to the end of October, and the two following ones, which developed entirely in stored beans, from early September to the end of February and from mid-November to mid-June, respectively. Migration of one generation to the field is not essential, for when infested beans were kept in the laboratory in closed jars, the development of the Bruchid continued uninterruptedly for over 5 years and ceased only when all the beans had been destroyed. The adults of the second generation are the most active in storehouses, while those of the third are always torpid and often inert. In investigations on the ability of the Bruchid to survive in beans sown in the field, small lots of beans infested by larvae, pupae and adults were placed under earth in a pot, in a seedling box and in the field under a bell. No individuals survived, and no living examples were found in samples of soil from infested fields. It is concluded, therefore, that infestation is spread in the fields solely by adults escaping from the storehouses [but *cf.* **23** 571].

Observations on adult feeding showed that both sexes fed on the parts round the embryos in beans, thus exposing the cotyledons, between which eggs were deposited. Excreta were observed when adults were kept in glass tubes, and the intestines of adults were shown to contain semi-digested matter of a starchy nature. Pairing occurred 12–24 hours after emergence ; males were able to fertilise 10–30 females at the rate of 5–6 a day. The numbers of eggs deposited by females of the four generations averaged 40, 50, 35 and 20. The larvae hatched in 6–18 days (average 10) depending on temperature, and bored into the cotyledons. Some entered through holes made by others. Having formed a cavity in which they live and feed, they moult. The first instar lasted 3–4 days in all four generations, but the numbers of days required to complete the further larval development were 15–20, 20–30, 30–40, and 60–180. The prepupal stage lasted a few days in all four generations, and the pupal stage averaged 4–6, 5–8, 6–10 and 5–8 days, respectively.

The injury caused to beans is described. There was little difference in the loss of germinating power in equally infested beans of seven varieties, or in the susceptibility to infestation of 41 varieties. Statements to the contrary are attributed to the fact that large beans are able to harbour more larvae than small ones, but this does not indicate a true preference. In the later generations and during the winter many pupae and newly emerged adults were found dead in the pupal cells in the cotyledons, and this mortality is attributed to the effects of temperature and humidity. Natural enemies of the Bruchid are reviewed from the literature ; none is of any practical importance. In special tests, the beetles were unable to perforate cellophane, so that small quantities of beans could be protected in cellophane bags. The various control measures that have been suggested for use in warehouses are discussed.

GRANDORI (R.) & GRANDORI (L.). **Effetti tossici prodotti da derivati della calciocianamide sulla mosca delle olive e sulle gambusie.** [The toxic Effects produced by Derivatives of Calcium Cyanamide on the Olive Fly and on *Gambusia*.]—*Boll. Zool. agrar. Bachic.* **9** pp. 46–51. Turin, 1940.

In continuation of work in Italy on calcium cyanamide as an insecticide [*R.A.E.*, A **27** 200, etc.], an investigation was made of the toxicity of its two derivatives, cyanamide and dicyandiamide, which were obtained by treating crude calcium cyanamide with water by methods that are described. Solutions of dicyandiamide were tested against house-flies and fish, but were not toxic to them [B **28** 147]. In tests with pure cyanamide, a few adults of *Dacus oleae*, Gmel., were bred from pupae, kept singly for a day or two without food, and then supplied with a solution containing 10–20 per cent. beet molasses and from 1 to 4·4 per mille cyanamide. This bait attracted the flies, and solutions of cyanamide at 2–4·4 per mille killed the flies in periods that ranged from 6 to 60 hours. The single male that was used as a control and was given an unpoisoned solution of beet molasses survived for over a month. Flies that had ingested the poison soon lost the power of flight and became more or less paralysed. The action of the poison was proportional to the amount ingested. In further tests, cyanamide proved toxic to fish.

GRANDORI (R.). **Esperimenti contro la mosca delle olive con nuovo dachicida alla cianamide.** [Experiments against the Olive Fly with a new Olive Fly Insecticide containing Cyanamide.]—*Boll. Zool. agrar. Bachic.* **9** pp. 238–249, 1 map. Turin, 1940.

An account is given of experiments in 1939 with bait-sprays poisoned with a 0·2 per cent. solution of cyanamide against *Dacus oleae*, Gmel., in olive plantations in a valley in the Italian Riviera. Nine applications were made between 12th July and 9th August ; 10 per cent. molasses was the bait in the first application, 4 per cent. glucose with 5 per cent. ammonium nitrate in the second, and 4 per cent. glucose alone in the others. The glucose was substituted for the molasses because it had proved more attractive to house-flies in laboratory tests. Dishes containing cotton-wool soaked in the bait were hung in some of the trees, but had little effect on the results as the liquid in them was not renewed often enough. Two growers also hung up bundles of ferns, which were thoroughly wetted with the liquid when the trees were sprayed. Calcium cyanamide was strewn on the soil in one plantation on 10th July to kill adults emerging from pupae in the ground, but as no rain fell until the end of July and thus the reaction producing cyanamide did not take place, the value of this measure was doubtful.

The percentages of olives infested at various dates are shown in tables. On 15th October, the percentages of uninjured fruit were 18·66, 17·91, 18·22, 38 and 43·7, respectively, in 5 areas, and 6·6 in an untreated plantation. The percentage of 18·66 was obtained in an area that adjoined heavily infested untreated plantations. The author briefly discusses these results and concludes that further experiments are justified.

Cosolo (S.). **La lotta contro la *Cydia molesta* del pesco nell'Agro Monfalconese nel 1938.** [Work against *C. molesta* in the Monfalcone Zone in 1938.]—*Boll. Zool. agrar. Bachic.* **9** pp. 52–56, 2 graphs. Turin, 1940.

In 1938, further evidence was obtained that the infestation of peaches in an orchard in the Monfalcone district of Italy by *Cydia molesta*, Busck, in 1937 was almost prevented by the removal of infested shoots [*cf. R.A.E.*, A **27** 199]. On 27th May, the 400 cases used for dispatch of the fruit and the 80 baskets used for picking in the previous season were placed in a closed storehouse and exposed to a temperature of 25°C. [77°F.] for 23 days. Only 5 adults of *C. molesta*, 11 of *C. pomonella*, L., and 1 unidentified moth emerged from them. Graphs show the numbers of larvae of *C. molesta* and *Anarsia lineatella*, Zell., collected at ten-day intervals from shoots in two orchards during the summer of 1938.

Provasoli (L.) & Ursone (G.). **Esperimenti di lotta contro la *Cydia molesta* sul pero e sul pesco.** [Experiments in Combating *C. molesta* on Pear and Peach.]—*Boll. Zool. agrar. Bachic.* **9** pp. 108–114, 3 refs. Turin, 1940.

Control measures in the winters of 1936–37 and 1937–38 greatly decreased the spring infestation of peaches by *Cydia molesta*, Busck, in Italy, and the removal of infested shoots in spring and summer resulted in a very low percentage infestation of the fruits of early varieties ripening in June and July. Such varieties are now generally grown, as they are less severely attacked than late ones. In practice, this results in the removal of infested shoots ceasing at the end of July, except by the few growers of late varieties, so that the moth is able to develop freely from July onwards. It also attacks autumn varieties of pears, which begin to ripen in July, August and September, and for its control on them sprays containing 0·5–0·7 per cent. lead arsenate are applied in mid-July and thereafter at fortnightly intervals, or less if rain necessitates immediate renewal of the deposit. In tests in 1937, a proprietary dust insecticide containing 35 per cent. barium fluosilicate and 4 per cent. of an adhesive was found as effective as a spray of lead arsenate against *C. molesta* and *C. pomonella*, L., on pears. Four or five applications are required between mid-July and harvest.

With a view to protecting late peaches against *C. molesta*, tests were made with a proprietary product composed of equal parts of naphthalene, crude alum, a mixture of ash of grape-vine and olive, wheat flour, and commercial sulphur. Preliminary tests having shown that a spray containing 0·6 lb. of this preparation, 1 lb. hydrated lime and 10 gals. water did not scorch the leaves, it was employed in a series of experiments that began on 4th August. The percentages of uninfested fruits were 53 for trees sprayed 5 times at intervals of 3 days, 42 for those sprayed 3 times at intervals of 5 days and 9 for the untreated controls. It is considered that applications should begin at least a month, and preferably 45 days, before the peaches are harvested.

CASATI (S.). **La Piralide del mais e la lotta contro di essa.** [The Maize Pyralid and its Control.]—*Boll. Zool. agrar. Bachic.* **9** pp. 115–150, 1 fig., 2 pls., 26 refs. Turin, 1940.

The author states that the importance of *Pyrausta nubilalis*, Hb., as a pest of maize in Italy has increased of recent years; that the pyrethrum spray tested against it on sugar sorghum [*R.A.E.*, A **27** 199] is too expensive for use on maize; that the destruction of maize stalks in the spring, though required by law, is never effected completely, and would not destroy all the larvae if it were, as many hibernate in other plants and in cracks in bark, walls, etc.; and that the method of biological control has proved of value in the United States and should be developed in Italy. In 1936–38, he investigated the general conditions governing the abundance of *P. nubilalis* and its relation to its parasites in Lombardy. He made counts of the borers and of the numbers of maize stalks attacked by them, and of parasite pupae in the tunnels. He then observed the numbers emerging in the laboratory. The results are shown in tables; all the parasites obtained were recorded in a paper already noticed [**20** 446]. He advocates breeding the parasites in the laboratory with *P. nubilalis* as the host, and advances as a favourable circumstance the fact that the parasites have long been acclimatised in Italy.

MALENOTTI (E.). **Dove andiamo con certi studi sulla Piralide?** [Where are certain Studies on *Pyrausta nubilalis* taking us?]—*Giorn. Agric. Domenica* 1939 no. 42, repr. 6 pp. Rome, 1939.

The author criticises recent suggestions for the control of *Pyrausta nubilalis*, Hb., on maize in Italy by chemical and biological measures. Successful experiments with pyrethrum have been recorded on sugar sorghum [*R.A.E.*, A **27** 199], but he considers that conditions must have been exceptionally favourable if no further eggs were laid after the single application of the spray, for *P. nubilalis* has two generations a year in Italy. The question of cost has also to be considered. He raises several objections to Casati's suggestion of the possibility of control by indigenous insect parasites [see preceding abstract]. The fact that the degree of infestation of maize in the United States, where the Pyralid is a comparatively recent introduction, has been considerably reduced by introduced parasites does not justify the supposition that any further reduction by biological control is obtainable in Italy, where the Pyralid and its parasites have persisted in a state of equilibrium for centuries and where the degree of infestation of maize is already far lower than in the United States. He considers that Casati has overestimated the number of sites other than maize stems in which the larvae are able to overwinter and denies that infestation in Italy has shown a definite increase.

PASCALET (P.). **La lutte biologique contre** *Stephanoderes hampei* **ou scolyte du caféier au Cameroun.**—*Rev. Bot. appl.* **19** no. 219 pp. 753–764, 1 graph, 1 fig., 8 refs. Paris, 1939.

The Braconid, *Heterospilus coffeicola*, Schmied., and the Bethylid, *Prorops nasuta*, Wtstn., which are the principal parasites of the coffee berry borer, *Stephanoderes hampei*, Ferr., are both present in the French Cameroons, and since in some regions they are of importance in

limiting the increase of the Scolytid, their introduction into infested plantations is recommended. This should be carried out by suspending from the coffee trees small baskets of coffee berries containing parasitised Scolytids.

The best control of the borer in the Cameroons, however, is given by the fungus, *Botrytis stephanoderis*, which is described and which is apparently identical with *Beauveria bassiana*, or at least closely resembles it. It occurs wherever the borer is present, irrespective of the variety of coffee ; it is particularly abundant in the forest zone and is favoured by heavy rains, which raise the humidity, lower the temperature and cause the females of *Stephanoderes* to shelter in the coffee trees, where they are likely to become infected. It is resistant to relatively low temperatures, and its development is most rapid at 22–30°C. [71·6–86°F.], this being the usual temperature in the central and southern Cameroons where robusta coffee is extensively cultivated. Development is retarded or ceases at higher temperatures, and the fungus cannot survive in very hot unshaded areas. Since the male Scolytids do not leave the berries in which they have developed, they are rarely infected by the fungus, and the females are attacked mainly during the period of about 2 weeks between leaving the berry in which they have developed and entering a fresh one for oviposition. Infection usually begins on the lower surface of the beetles, to which the conidia adhere, and subsequently the resulting mycelium penetrates the integument ; in some cases, the fungus enters by way of the digestive tract. Infected beetles die in 3–6 days, but the fungus continues to develop vigorously on them. If an infected female has time to oviposit, the number of eggs laid is greatly reduced, and the resulting larvae or pupae sometimes become infected.

In experiments in which the beetles were kept in a saturated atmosphere and in that of the laboratory and were dusted with spores of the fungus cultured on a sterile medium, the percentage mortalities were 30 and 0 on the third day, 100 and 80 on the sixth day and 100 and 100 on the ninth day ; in those kept in tubes these percentages were 20, 55 and 100. In further experiments, at a temperature varying from 22 to 28°C. [71·6–82·4°F.] and humidities of 95, 69–90 and 50–55 per cent., the percentage mortalities of beetles contaminated with spores of the fungus taken in the field were 30, 10 and 10 on the third day, and 97, 40 and 100 on the sixth ; in the case of beetles contaminated with spores from cultures, the corresponding percentages were 30, 20 and 20, and 100, 90 and 50. These tests indicated that there was little difference in the spread of the infection at low and high humidities, which is probably due to the fact that the initial dispersion of the fungus is favoured by a dry atmosphere ; its further development, however, was shown to be inhibited by lack of humidity. It is concluded that the conditions favourable to an extensive outbreak of the fungus, whether occurring naturally or as the result of artificial distribution, are a dense population of the borer ; a temperature of 20-30°C. [68–86°F.] ; and sufficient rain to produce the relative humidity necessary for vigorous sporulation followed by 1–2 sunny days to induce even dispersion of the spores, and then by light rains or mists that would favour the development of the spores on the beetles.

Of all the measures of natural control recommended against *Stephanoderes*, the dissemination of the fungus appears to be the most effective. It should be applied in the form of an aqueous suspension

of the spores and in the early morning before sunrise, preferably during damp weather. If hot dry weather follows the application, it is advisable to spray the treated coffee berries with water. A successful application over some 2½–5 acres in each 124 acres is probably sufficient, as the fungus will be carried by the beetles themselves over the rest of the area. The medium recommended for culturing the fungus is slightly peptonised rice with a pH of 5·4, produced by the addition of a solution of decinormal tartaric acid. It is kept in bottles of one litre capacity, containing 10 gm. rice, 0·1 gm. peptone and 25 cc. water and is sterilised twice at 130°C. [298°F.] at an interval of 48 hours, after which a pure culture is sown on it.

WALLACE (G. B.). **French Bean Diseases and Bean Fly in East Africa.**—*E. Afr. agric. J.* **5** no. 3 pp. 170–175, 13 refs. Nairobi, 1939.

Notes are given on the symptoms and control of various diseases of French beans in Tanganyika. They include common mosaic, which also occurs in Kenya. The virus is transmitted in the United States by *Macrosiphum solanifolii*, Ashm., *Aphis rumicis*, L., and *Myzus persicae*, Sulz., of which the last two are present in East Africa.

Considerable damage is caused to French beans in some districts by *Agromyza phaseoli*, Coq. This fly was recorded from Tanganyika for the first time in 1936, and is not well known, probably owing to its small size and to the inconspicuousness of the primary injury, which occurs mostly at ground level [*cf. R.A.E.*, A **26** 335]. In infested plants, the collar becomes swollen and brown and the skin raised and cracked. The larval stage lasts 10–20 days. In the Tanga and Northern Provinces, larvae and pupae were found in January. In February only pupae were observed, and by the end of the month adults had emerged from all pupae examined.

M. Halcrow has informed the author that *A. phaseoli* is also of importance in Kenya, where the percentage infestation of beans varies considerably and reaches 100 at 4 centres, and where parasitism by an undetermined Braconid amounts to 50 per cent. in October and November. The food-plants of the larvae are reviewed from the literature, and very brief notes are given on other Agromyzids that attack leguminous crops.

Control measures suggested on the basis of experience in other countries include the destruction of plants remaining after harvest in the fields, and of self-sown plants and leguminous weeds that may harbour the pest during the dead season of the main crop; earthing up the plants, which induces them to throw out new roots above the infested part; burning all seriously infested plants immediately and the remainder after harvest; and avoiding successive crops of susceptible plants.

SMIT (B.). **Mushroom Insects and their Control.**—*Fmg in S. Afr.* 1939 repr. no. 104, 1 p. Pretoria, 1939.

Considerable interest has recently been taken in the growing of mushrooms in South Africa, but many crops have been destroyed by pests, including mites, woodlice, Mycetophilids, Borborids, and Phorids. Measures employed against such mushroom pests in other countries are recommended for their control.

Mamet (R.). **The Aphididae of Mauritius.**—*Mauritius Inst. Bull.* **1** pt. 5 pp. 43–56. Mauritius, 1939.

A systematic list is given of the Aphids of Mauritius, showing their food-plants and synonomy and the natural enemies of some of them, with keys to the subfamilies, tribes, genera and species and a list of plants showing the Aphids that attack them. In general, Aphids are not important pests in Mauritius. *Aphis gossypii*, Glov., has a relatively wide range of food-plants and is probably the most injurious. It sometimes occurs on tobacco, but not as a pest. Sugar-cane is attacked only by *A. sacchari*, Zehnt., which does some damage to young plants, but is largely controlled by natural enemies [*cf. R.A.E.*, A **28** 244]. *A. citricidus*, Kirk., of which *A. tavaresi*, Del G., is a synonym, is very harmful to young *Citrus*, but its attacks are only sporadic, and *Macrosiphum nigrinectaria*, Theo., does some damage to *Cajanus cajan*. *Myzus persicae*, Sulz., is present, but is not a pest in Mauritius. *A. maidis*, Fitch, attacks maize [*cf. loc. cit.*], and *Pentalonia nigronervosa*, Coq., infests banana, *Caladium* sp. and *Alocasia macrorhiza*. These two Aphids are known to transmit mosaic disease of sugar-cane and other graminaceous plants and bunchy-top of banana, respectively, in other countries, but no investigations have been made on their ability to act as vectors of virus diseases in Mauritius.

Kaburaki (T.), Kamito (A.), Iwasa (T.), Iyatomi (K.), Dōke (N.), Sugiyama (S.) & Aino (S.). **Studies on Rice Borers III. The Biology of the Rice Borer, *Chilo simplex* Butler, with special Reference to Phototaxis and Chemotaxis.** [*In Japanese.*]—*Minist. Agric. For. Japan Dep. Agric., Nozikairyosiryo* no. 140, 2+178 [4] pp., 45 figs. Tokyo, 1939. (With a Summary in English.)

This paper, which is the third of a series [*cf. R.A.E.*, A **21** 568 ; **22** 664], comprises a detailed account of laboratory investigations in Japan on certain aspects of the biology of *Chilo simplex*, Btlr. The subjects dealt with include the reactions to light of the larvae, which were positively phototactic for 4 hours after hatching, then negatively so until the time of spinning the cocoon ; the effect of the time of day on hatching, pupation, adult emergence, pairing and oviposition, and on the oxygen consumption and degree of attraction to light of both males and females ; the changes in oxygen consumption associated with the development of the various stages ; the relations between the body weights of the overwintered larvae and the resultant adults of both sexes ; and between the body weight of the larva and its own length and that of the resultant adult ; the behaviour of pupating larvae of the overwintering generation ; the number of eggs contained by the females (which averaged 558) and the proportion of these deposited (50–60 per cent.) ; the biotic potential and survival coefficient ; and the effect of mating on longevity.

An account of the behaviour of the moths when stimulated by light includes information on the minimum and optimum luminosities causing phototactic response and the effect on the latter of the wave-length of the light [*cf.* **27** 441], its diffusion and the temperature of the electric filament used as its source. The adults, particularly the females, were positively chemotactic to the rice plant and to honey, but not to molasses or acetic acid ; the male was

positively chemotactic to the female. Descriptions are given of sensory structures acting as olfactory and tactile organs on various parts of the body, and the reaction to light and darkness of the compound eye.

DE FLUITER (H. J.). **Het witte luis-vraagstuk bij de koffie.** [The White Mealybug Question in Relation to Coffee.]—*Bergcultures* **13** no. 23 pp. 760–765. Batavia, 1939.

The results are given of investigations in Java on the life-history and control of the coffee mealybug, *Pseudococcus citri*, Risso. Lamtoro (*Leucaena glauca*) is its primary food-plant in plantations above 2,000 ft., and coffee at lower altitudes, where it passes to *Leucaena* if infestation is severe. This difference in infestation necessitates different methods of control [*cf. R.A.E.*, A **26** 182; **27** 161]. Infestation was consistently heavy in plantations in which *Anoplolepis* (*Plagiolepis*) *longipes*, Jerd., was numerous, but in those from which this ant was absent it was sporadic and seldom occurred in the same plots in successive years [*cf.* **25** 298]. The chief crop loss of coffee occurs in the year following infestation. Infestation was repeatedly observed to be serious only in the dry season, and sporadic in the rainy season, provided that *A. longipes* was absent. Relative atmospheric humidity at the temperatures usual in the plantations has no direct effect on development or mortality. In the rainy season, *Empusa fresenii* is the chief cause of mortality, but in the dry season, the effect of this fungus is negligible, and control is exercised by predators and parasites.

It is well known that *P. citri* is generally more abundant in unshaded than in shaded plantations. Observations have indicated that the differences in temperature and humidity in the dry season are not sufficiently great to account for this. In experiments on the effect of light, young coffee plants were kept in cages of light and dark gauze at equal temperatures and humidities and protected from direct sunlight, rain and wind, and a colony of the mealybug was placed on each plant. In the cages of light gauze, the young larvae that were produced usually preferred the young green parts of the plants and the shoots, and almost all those that settled on young growth gave rise to females [*cf.* **25** 509]. Most of those that settled on the older leaves gave rise to males, and the percentage of males varied directly with the increase in age of the leaves. In the darkened cages, many larvae left the plants, and of those that remained, most gave rise to males on both young and old leaves. Development to the adult stage was twice as rapid in the light cages, and the plants in them became much more heavily infested. It is considered that these differences were due to the physiological action of light on the food-plant. Investigations on the occurrence of parthenogenesis, in which all the male pupae that developed in one of two colonies of the mealybug were removed, showed that there were no significant differences in the sex ratios, mortality or the duration of development in the two colonies after eight generations.

Infestation in the field begins to increase as soon as the average monthly relative humidity at noon falls below 70 per cent. [*cf.* **25** 298], a condition that normally coincides with the advent of the dry season, and reaches its peak 3–4 months later. Having reached its maximum, the infestation soon collapses owing to lack of food-supply,

a reduced rate of reproduction and natural enemies, of which the chief are indigenous Coccinellids (*Brumus suturalis*, F., and two species of *Scymnus*). These Coccinellids, all of which have a high rate of reproduction, a short developmental period and a long adult life, but are not numerous until the end of the dry season, can be bred in large numbers during the rainy season on *Pseudococcus lilacinus*, Ckll. (*tayabanus*, Ckll.) and liberated against *P. citri* at the beginning of the dry season. If the outbreak persists until the rains, it is usually controlled by *Empusa fresenii*.

P. citri can also be controlled by increasing the amount of available shade in the plantations. This method is undesirable in the case of robusta coffee [*cf.* **27** 161], but is entirely suitable for Java [arabica] coffee at high altitudes. Very good results have been given by a combination of *Leucaena*, dadap [*Erythrina*] and *Albizzia*, which provide three covers one above the other; or in some cases the *Erythrina* is unnecessary. The mealybug occasionally infests *Leucaena* in such plantations if the dry season is prolonged, but is easily controlled by pruning. Since it infests mainly the flowers and pods of *Leucaena*, infestation can be prevented by planting *L. pulverulenta*, which flowers very seldom, or a sterile hybrid of *L. glauca* and *L. glabrosa*.

Spraying with insecticides is difficult on robusta coffee, as the bushes are thick and shelter the mealybugs, but is easier on Java coffee. The method is expensive, however, and is not justified at the current price of coffee. Fair results have been given by a proprietary emulsion of Solar oil, soap and glue, which under climatic conditions favourable to the mealybug delayed the peak of infestation for 4–6 weeks. It is more effective under conditions unfavourable to *P. citri*.

DRAKE (C. J.) & FRICK (D. M.). **Synonymy and Distribution of the Lantana Lace Bug (Hemiptera : Tingitidae).**—*Proc. Hawaii. ent. Soc.* **10** no. 2 pp. 199–202, 1 fig. Honolulu, 1939.

The authors give a brief account of the distribution of *Teleonemia scrupulosa*, Stål, of which *T. lantanae*, Dist., is a synonym and which has been introduced into Hawaii, Australia and Fiji for the control of weeds of the genus *Lantana*. The only records of this Tingid from plants other than *Lantana* are from Texas, where it was observed on *Callirhoë involucrata* and an undetermined species of the mint family. It also occurred on *Lantana* in Texas and seems unable to breed or live very long on other plants. A list is given of the synonyms of *T. scrupulosa* and of records in the literature that refer to it, and characters distinguishing it from closely allied species are briefly described.

SAKIMURA (K.). **On the Host Plants of some Hawaiian Thrips.**—*Proc. Hawaii. ent. Soc.* **10** no. 2 pp. 251–254, 10 refs. Honolulu, 1939.

Records, chiefly obtained on the island of Oahu in 1938, are given of the food-plants of a number of species of Thysanoptera in Hawaii, together with the results of a study of the plants attacked by *Thrips nigropilosus*, Uzel. It was thought that this species might be a vector of yellow spot disease of pineapple and *Emilia sonchifolia* [*cf. R.A.E.*, A **28** 381], but the author is publishing a paper to show that it does not transmit this disease. The geographical distribution of

T. nigropilosus is briefly reviewed and a list of its food-plants is compiled from the literature. In Hawaii, it was first discovered in 1935, when it severely injured lettuce in a garden in Oahu. It was subsequently collected on wild plants on two other islands, and on lettuce (to which it was sometimes injurious), chrysanthemum, egg-plant and carrot, in a number of districts in Oahu. The material from chrysanthemum included brachypterous males, which were the first males collected in Hawaii. Under experimental conditions, large colonies of this thrips were reared on *Emilia sonchifolia*, spinach, celery, potato and *Datura stramonium*, but the adults died in a few days and could not establish colonies on young seedling pineapple plants, tomato, tobacco and garden petunia.

Zimmerman (E. C.). **A new Fijian *Diathetes* injurious to *Pandanus* (Coleoptera : Curculionidae).**—*Proc. Hawaii. ent. Soc.* **10** no. 2 pp. 335–338, 2 figs. Honolulu, 1939.

A detailed description is given of the adults of both sexes of *Diathetes pandanae*, sp. n., which was observed in August 1938 infesting a recently felled *Pandanus* tree on the seashore on Vanua Mbalavu, Fiji. The diagnostic characters of the larva are shown in a figure. This weevil may prove to be a major pest of *Pandanus* trees, which are of considerable economic importance in eastern Oceania. The hearts of the trunk and limbs were reduced by the larvae to a mass of frass, and isolated individuals also occurred in the solid wood in various parts of the tree, which had evidently been attacked when growing and apparently healthy.

Miller (D.). **Termites or "White-ants."**—*N. Z. J. Sci. Tech.* (B) **21** no. 2 pp. 57B–65B, 6 figs. Wellington, N.Z., 1939.

The problem of insects attacking constructional timbers has become more difficult in New Zealand since the recent discovery of the establishment there of certain destructive species of Australian termites. An account is given of the bionomics of termites in general ; the species native to New Zealand are dry-wood termites, and both dry-wood and subterranean termites have been introduced from Australia. The native species are responsible for a considerable amount of localised damage in wooden structures and furniture and are widespread. The dry-wood termites that have reached New Zealand from Australia have been observed so far only in railway sleepers and hardwood poles. Subterranean termites from Australia have become established at Auckland and New Plymouth, and possibly in other places, and are causing anxiety on account of their potential destructiveness. Houses built of either native or exotic timber can be extensively and seriously damaged by these insects in less than six years. Specimens sent to Australia were identified as *Coptotermes lacteus*, Frogg. [*cf. R.A.E.*, A **28** 99], and later examination of larger collections showed that *C. acinaciformis*, Frogg., was also established. Recommendations are given for the prevention of attack by subterranean termites [*cf.* **17** 730 ; **18** 114] and for the control of existing infestations by working creosote or naphthalene into the soil round wooden posts, etc. Buildings should be kept in a good state of repair to prevent attack by dry-wood termites, the winged forms of which enter any convenient crack. Regular inspections should be made of wooden buildings, and the marketing of infested timber should be forbidden.

Insect Pests and their Control.—*Agric. Gaz. N.S.W.* **50** pt. 11 pp. 628–632, 8 figs. Sydney, 1939.

This part of a series on insect pests in New South Wales [*cf. R.A.E.*, A **28** 287] includes notes on *Bruchophagus gibbus*, Boh. (*funebris*, How.), which infests the seeds of lucerne and sometimes considerably reduces lucerne seed crops. This Eurytomid has several generations a year, and overwinters in the larval stage. If lucerne for seed is grown to mature early in the season, appreciable losses due to *B. gibbus* and *Nezara viridula*, L., both of which reach their greatest numbers in February and March, are avoided. *Nezara* sucks the sap from the pods, preventing the formation of seed. If conditions are favourable, the lucerne can be cut early in November and the second growth allowed to develop for seed. The seed crop should be removed without delay. The fields should be cultivated in late autumn or early winter, so that fallen seeds containing hibernating larvae are covered with moist soil, which causes many of them to become mouldy and prevents the development of the insects. Lucerne growing on waste land should not be allowed to seed.

ATHERTON (D. O.). **White Grubs and Pasture Deterioration on the Atherton Tableland.**—*Qd agric. J.* **52** pt. 5 pp. 484–522, 7 figs., 1 map, 1 diagr., 18 refs. Brisbane, 1939; also as *Pamphl. Dep. Agric. Qd* no. 65, 40 pp., 7 figs., 1 map, 1 diagr., 18 refs.

The productiveness of pastures in the Peeramon district of the Atherton Tableland in Queensland, where *Paspalum* is the dominant grass, has markedly decreased in recent years, and their carrying capacity is now less than half what it was some 30–40 years ago when the rain-forest was cleared. The factors responsible for this deterioration include serious injury by the larvae of *Lepidiota caudata*, Blkb., the area infested by which has increased from 10,000 acres in 1930 to 25,000 in 1935. The damage appears to be confined to pastures, and no direct attack on cultivated crops has been recorded. The activity of the larvae is greatest just before winter and increases the shortage of food for stock during the dry season (July–November). Brief notes are given on the bionomics of this Melolonthid [*cf. R.A.E.*, A **20** 155; **25** 162], and a detailed survey is made of the condition of pastures in the district, with suggestions for improvements based on investigations and experiments.

The following is taken largely from the author's summary and conclusions: White grubs are not solely responsible for the deterioration of the pastures, since soil fertility inevitably declines following the clearing of rain-forest. Direct measures against them are economically unjustified [*cf.* **25** 163]. Some control is exercised by the toad, *Bufo marinus*, which has been introduced from the adjoining coastal sugar-cane fields; 15–20 thousand young toads have been liberated on the Tableland, and although the altitude at which the pastures occur (about 2,400 ft.) may inhibit breeding, some introduced individuals have reached maturity and survived the climate for over a year. Considerable control of *L. caudata* is afforded by allowing pigs to range over pastures during the flight season of the adults. The reduced carrying capacity of deteriorated or grub-infested pastures must be offset by changes in farm management largely similar to those already suggested [**25** 163]. Suitable grasses for resowing and

possibilities of growing lucerne are discussed. All dead tree trunks and stumps should be removed, as the beetles concentrate round them immediately before oviposition.

SMITH (J. H.). **Red Scale on *Citrus* Trees.**—*Qd agric. J.* **52** pt. 5 pp. 523–528, 1 fig., 1 ref. Brisbane, 1939; also as *Ent. Leafl. Dep. Agric. Qd* no. 29 (revd) 6 pp., 1 fig.

This paper on the biology and control of *Aonidiella aurantii*, Mask., on *Citrus* in Queensland is a revision of a previous one [*R.A.E.*, A **23** 761]. The control measures recommended are similar to those in an earlier paper [**22** 711].

BELL (A. F.). **Report of the Division of Entomology and Pathology.**—*Rep. Bur. Sug. Exp. Stas Qd* **39** pp. 45–59. Brisbane, 1939.

In the year ending June 1939, there was an appreciable increase in the infestation of sugar-cane by larvae of *Lepidoderma albohirtum*, Waterh., in northern Queensland, following weather conditions favourable for adult emergence during October–December 1938 and continued rains early in 1939, which favoured the survival of the eggs and young larvae. These conditions also prolonged the life of the infested canes. Little damage was apparent before the rains ceased, and in most cases it was possible to mill the injured canes. In view of the fact that in some places in which comparatively few adults had been observed, damage became apparent on the canes too late for fumigation, which should be carried out while the larvae are in the second or early third instar, the importance is emphasised of locating and treating infested areas early in the season.

The long wet season was also favourable to *Bufo marinus*, which bred in places that are normally dry and is believed to have reached peak populations at the original points of release [*cf. R.A.E.*, A **26** 56]; the toad has also become established at places where later liberations have been made. Difficulty is expected in maintaining effective populations during dry years on high, dry red volcanic soils, which are sparsely covered and become very hot during the spring months before the adults of *Lepidoderma* emerge, and on which the unit damage caused by larvae to cane is particularly high. Comprehensive experiments established that fowls suffered no ill-effects when fed on *B. marinus* or given drinking water contaminated by toads. The remains of insects representing several Orders and at least 21 families were found among the stomach contents of toads; they included *Rhabdocnemis obscura*, Boisd., *Laphygma* (*Spodoptera*) *exempta*, Wlk., and *Lepidiota frenchi*, Blkb., and the majority were Lamellicorns.

In further investigations on the effect of trashing on *R. obscura* [*cf.* **27** 185], the numbers of borers were reduced by rather more than half on canes that were kept free from trash throughout the whole season, but when treatment was restricted to either the early or the late stages of growth the reductions were too small to be of value. As no significant difference in tonnage resulted from any of the treatments, and the content of available sugar in the cane was not materially affected, the method cannot be recommended for borer control. Investigations on the selective breeding of non-susceptible varieties was continued. Infestation by larvae of the Elaterid, *Lacon variabilis* Cand., was much less extensive than during the two previous years

probably as a result of the late wet season. The period from December to February is considered to be the most critical in determining survival. *Coptotermes acinaciformis*, Frogg., caused slight injury to mature cane, and a mound-building ant, *Aphaenogaster pythia*, Forel, caused stunting by tunnelling beneath the stools [*cf.* **28** 316].

In the Bundaberg district, the Coccid, *Aulacaspis madiunensis*, Zehnt., which is a native of Java, where it is of little importance, has become well established on sugar-cane and is seriously affecting the juice of P.O.J. 213, which was more heavily infested than other varieties. Limited infestation of the same variety by an undetermined Coccid of the genus *Margarodes* caused patches of cane to die out or become stunted. Bare fallowing during spring and summer is recommended for control. At the Bundaberg Sugar Experiment Station, the central hearts of about 5 per cent. of seedling canes were destroyed after potting out by larvae of an Anthomyiid of the genus *Atherigona*, but the seedlings later recovered.

Parasites bred during the year included the Aphelinid, *Physcus nigriclavus*, Gir., from *A. madiunensis*, and the Tachinids, *Sturmia inconspicuella*, Baranov, and *Carcelia kockiana*, Tns., from *Cirphis loreyi*, Dup. [*cf.* **27** 186].

WOMERSLEY (H.). **Primitive Insects of South Australia.**—Med. 8vo, 322 pp., 1 col. pl., 84 figs., 9 pp. refs. Adelaide, S.A. Branch Brit. Sci. Guild, 1939. Price 7*s.* 6*d.*

This handbook, which is the first of a series on the insects of South Australia, deals with the Apterygota of Australia as a whole. Apart from a complete series of keys, it consists mainly of descriptions of the various species, some of which are new, with notes on their distribution. The collection and preservation of specimens are the subject of a short appendix. The author recognises four Orders, Thysanura, Diplura, Collembola and Protura. The Diplura and Protura are of no economic importance, but several species of Collembola and Thysanura are well known as pests in South Australia ; many indigenous species may at times reach injurious numbers because of the current methods of intensive cultivation, and other species, introduced from abroad, are potential pests. Special attention is drawn to those that are probable introductions and therefore likely, under favourable conditions, to become pests. The zoogeographical relationships of the Australian Collembola are discussed and their distribution is shown in a table. Lists are given of the species of this Order that are injurious in various parts of the world, showing which of them are indigenous in Australia or have been introduced there, and of the species that have been introduced but are not known to be injurious. *Smynthurus viridis*, L., is the most important species, and has become one of the major pests of Australia in recent years, owing to the great increase in the planting of leguminous pasture plants.

GIMINGHAM (C. T.) & BUCKHURST (A. S.). **Report on Insect Pests of Crops in England and Wales 1935–1937.**—*Bull. Minist. Agric. Fish.* no. 118 vi+64 pp., 1 map, 234 refs. London, H.M.S.O., 1939. Price 1*s.*

This bulletin is prepared on the same lines as the previous one [*R.A.E.*, A **24** 457] and records the incidence of the more important agricultural and horticultural pests in England and Wales during

the years 1935–37, together with notes on recent developments in methods of control. A list is appended of references to papers concerned with insect pests and their control that were published in Great Britain during this period.

Monte (O.). **Coleobrocas da mandioca.** [Coleopterous Borers of Cassava.]—*Biologico* **6** no. 1 pp. 15–18, 4 figs. S. Paulo, 1940.

The stems of cassava in Brazil are infested by the larvae of the weevils, *Coelosternus rugicollis*, Boh., *C. granicollis*, Pierce, *C. notaticeps*, Mshl., *C. manihoti*, Mshl., and *Eulechriops manihoti*, Monte, the adults of which are briefly described. The eggs of *Coelosternus* spp. are laid in the bark, and the larvae enter the lower part of the stems and bore downwards through the centre as far as the subterranean part of the plant. Those of *E. manihoti* attack the stem in numbers beneath the bark. Only one larva of *C. rugicollis* occurs in each stem, whereas up to four of *C. manihoti* have been observed. The length of the larval stage is not known, but the pupal stage lasts about a month. The newly emerged adult remains in the stem for some time before making its exit. The only available control measure is to remove and burn infested stems and to clean up the fields at harvest.

Greenslade (R. M.) & Pearce (S. C.). **Field Sampling for the Comparison of Infestations of Strawberry Crops by the Aphis** *Capitophorus fragariae* **Theob.**—*J. Pomol.* **17** no. 4 pp. 308–317, 5 refs. London, 1940.

The following is taken from the authors' summary of work in south-eastern England carried out to discover a method of comparing populations of the strawberry Aphid, *Capitophorus fragariae*, Theo., which, because it transmits virus diseases from plant to plant, is the most serious pest of commercial strawberry fields in the British Isles: The method of sampling devised consists of counting the Aphids on a number of sample leaves, one leaf being taken from each of a number of equal sized blocks into which the field is divided. It is shown that the quantity $\sqrt{n+\frac{1}{2}}$, in place of the actual number of Aphids on a leaf, n, enables considerably better comparison to be made between different samples. Evidence is advanced to show that the standard deviation of $\sqrt{n+\frac{1}{2}}$ within a block of less than 500 plants rarely exceeds 1·3.

Tooke (F. G. C.). **Investigations on the Biology of** *Euproctis terminalis*, **Walk., the Pine Brown Tail Moth and its Control by Aeroplane and Ground Dusting.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 179, 48 pp., 17 figs., 1 diagr., 1 col. pl., 2 fldg maps, 2 refs. Pretoria, 1938. Price 3*d*. [Recd. 1940.]

Since the first record in 1929 of a severe infestation of pines by *Euproctis terminalis*, Wlk., in the eastern Transvaal [*cf. R.A.E.*, A **24** 335], outbreaks of this Lymantriid have occurred in plantations over a considerable area in the north and east of the province and in the Orange Free State. The history of these outbreaks is reviewed and all stages of the moth are briefly described. The larvae have not been found on any native shrub or tree. The trees severely infested are *Pinus patula* and *P. leiophylla*; *P. radiata* (*insignis*), *P. pinaster*, *P. taeda*, *Acacia mollissima* and *A. dealbata* are attacked, but are only

rarely defoliated. When growing in close proximity to infested pines, *Quercus palustris* is sometimes heavily infested by larvae in the first and second instars, but as this oak normally drops its leaves during the main development period of the larvae, it is unlikely that infestation could persist in pure stands. Two species of *Eucalyptus* have also been attacked, but the larvae are apparently unable to complete their development on them.

The female moths deposit 100–300 eggs in a single elongated cluster, usually on the upper surface of a twig near the end, but also on the bark of the bole, and, in the case of pines, on the needles, several of which are cemented together to form a basis. Oviposition may occur as early as the last week in December and as late as the end of March, but most eggs are laid during February and March. The larvae, which hatch in 20–25 days, are at first gregarious and usually feed on the terminal leaves of the twigs ; later they scatter to all parts of the tree. Since they feed throughout the winter, the duration of the various instars varies considerably with weather from season to season. The larvae are sluggish in the presence of abundant food or in cold weather, but are active during the hot hours of the day or when food is scarce. They suspend themselves on long silken threads and also spin silk from twig to twig as they feed. On pines, they cut through the needles, so that 50 per cent. of the foliage falls to the ground. Pupation, which begins in early September, occurs in cocoons in the mat of pine needles at a depth of 2–3 ins., but cocoons can also be found round the bases of the trees or anywhere on the forest floor. The pupal stage lasts 4–6 weeks or longer, depending on the weather. The adults begin to emerge in the second half of September, but the bulk of emergence occurs in January and February.

The nature and extent of damage caused by the feeding of the larvae on the foliage is discussed. Owing to the natural vigour of *P. patula* and *P. leiophylla*, and to the fact that defoliation usually coincides with the commencement of the rainy season, the trees recover rapidly after the larvae pupate, provided that there is enough rain. Very little defoliation occurs during winter. The infested trees, however, usually suffer a severe setback, resulting in loss of increment and vigour. Successive seasons of defoliation must have a serious cumulative effect on the trees, and furthermore it has been observed in recent years that there has been a notable increase in the periods during which the adults emerge and the larvae are present on the trees, so that larvae can now be found practically throughout the year. If this condition continues, it is considered that the moth may possibly develop a second generation in the year, which would result in additional defoliation in autumn.

In April 1937, 88 per cent. of the egg clusters of *E. terminalis* taken in two localities in the eastern Transvaal were parasitised by an undescribed species of *Telenomus*. All the clusters were collected at the end of the oviposition period low down on trees exposed to the sun at the edges of the plantations. A species of *Pimpla* and *Theronia melanocera*, Hlmgr., parasitise the pupae ; the first of these Ichneumonids is very abundant, particularly during December and January, but *T. melanocera* is comparatively rare. Two adults of a Tachinid, probably a species of *Sturmia*, have recently been reared from the cocoons. An outbreak of polyhedral disease occurred among the larvae during the season of 1930, causing heavy mortality, but they appear normally to be highly resistant to it.

Calcium arsenate dust was applied from an aeroplane in August–September 1936 over nearly 2,000 acres of infested pines at an altitude of 6,000 ft. in the eastern Transvaal. The average rate of application was 15–20 lb. per acre, but some variation occurred owing to drift and other factors. Measurements of the deposit on glass plates showed that it was greatest at the level of the top of the crown and diminished steadily as the dust made its way downwards. The dust adhered well to the foliage of *P. patula* owing to the resinous secretion from the needles, and an examination ten days after driving rain showed that only a small proportion had been washed off. The aeroplane used proved unsuitable for this type of work, as it was dangerous to fly at less than 80 ft. above the tree tops and contour flying was impossible. The results were estimated by the amount of fallen needles under the trees before and after dusting, counts of pupae in treated and untreated areas two months later, and the appearance of the trees. In general, a very good mortality of the larvae was obtained, and only occasional pupae could be found in November. The trees lost very little foliage after they were dusted and the damage was confined to the lower branches. Requirements for a more suitable type of aircraft are outlined. The dust should be released not more than 50 ft. above the trees to avoid excessive drift. At an altitude of 6,000 ft., it is not advisable to apply it in the afternoon, as rising currents of warm air prevent it from settling.

In 1937, calcium arsenate was applied from the ground with a power duster over 370 acres, including some areas that had not been treated in 1936. The average rate of application was 35 lb. per acre, but owing to air currents, etc., the deposit on the trees probably did not exceed 20 lb. per acre. The best time for dusting was from early morning until 11 a.m. On the whole, very satisfactory control was obtained ; in one part of the infested area defoliation ceased within a week of the treatment, and in two others the percentage larval mortalities were about 60 and 80.

The relative merits of dusting forest trees from an aeroplane and from the ground are discussed ; it is concluded that the former method gives a better distribution of the dust and is no more expensive than the latter. Dusting from the ground, however, is more suitable for infested areas of 500 acres or less and for localised infestations.

Ripley (L. B.), Hepburn (G. A.), Petty (B. K.) & Dick (J.). **The Wattle Leaf-tier.**—*Fmg in S. Afr.* 1939 repr. no. 94, 3 pp., 7 figs. Pretoria, 1939.

Although *Polychrosis incultana*, Wlk., occurs throughout the wattle belt in Natal, it has not hitherto been sufficiently abundant to attract attention. In the summer of 1937–38, however, an outbreak of this Tortricid occurred on small wattle trees on a single estate and in the following summer extensive infestations appeared in three widely separated areas. In one of these, the trees were also infested by larvae of the Noctuid, *Achaea lienardi*, Boisd., and by Jassids and Capsids, the combined attack causing much damage to young trees. Injury by *P. incultana* was confined to young trees up to 12 ft. high ; black wattle [*Acacia mollissima*] was preferred, but green wattle [*A. decurrens* var. *normalis*] was also attacked. The larvae have been reared from bunches of pods of *Dichrostachys glomerata* in Pretoria and apparently

also attack indigenous species of *Acacia*. The sudden increase in infestation of wattle in 1938–39 may have been due to the very wet season, which probably restricted the activity of parasites, although the outbreak in 1937–38 was not associated with exceptionally wet conditions. All the three districts concerned have a relatively warm climate.

The larva of *P. incultana* spins silk throughout its development, fastening together the end leaves of branches to form a loose nest, within which it feeds and pupates. Shaking the branches does not usually dislodge the larvae, but when the nests are torn apart they drop to the ground. There are probably five generations during the summer and autumn, each occurring at intervals of about one month, and the winter is passed in the pupal stage. Presumably the larvae are not very numerous during the first two or three generations, as outbreaks have so far been observed only in late summer. In extreme cases, the trees are almost completely defoliated. Parasites of *P. incultana* include an Ichneumonid, a Chalcidoid and a Tachinid. In one district, 86 per cent. of the pupae were found dead in May, of which half had been killed by parasites and some by fungi.

In experiments on control, a cryolite dust was ineffective, as it did not penetrate the nests sufficiently. A dust of pyrethrum and talc (1 : 20) applied at the rate of about 15 lb. per acre to trees 8 feet high caused over 75 per cent. of the larvae to fall to the ground, mostly within 30 minutes. About 27 per cent. of these were not killed, but it was shown by applying adhesive bands to the trees that hardly any were able to crawl up the trunks again. The effectiveness of the dust was not increased by doubling the concentration of pyrethrum or by a higher rate of application. To obtain a comparable control with a dust of dinitro-ortho-cresol, a very heavy dosage was required, which scorched the terminal growth of the trees.

WASHBOURN (R.). **On the Distribution of** *Leucoptera daricella* **(Meyr.) ; with the Description of a new Leaf-miner from Coffee.**—*Bull. ent. Res.* **30** pt. 4 pp. 455–462, 1 pl., 4 figs., 12 refs. London, 1940.

The author records the results of an examination of the specimens labelled *Leucoptera daricella*, Meyr., in the collections of the British Museum and of the late E. Meyrick, and also gives a brief survey of records of this Tineid from various countries. The specimens examined included material from Queensland, Ceylon, India and Burma, one specimen from Natal, one, reared from coffee, from Kenya, and many, reared in 1933 from coffee [*cf. R.A.E.*, A **23** 664] or *Cremnospora africana*, from Tanganyika. Among them were the type specimens of *L. daricella* from Queensland and of two Asiatic species described by Meyrick, but subsequently considered by him to be synonyms of it. The original descriptions of these three species are quoted, and additional characters distinguishing them are described. The author concludes that none of the Asiatic or African specimens is *L. daricella*, which is thus a purely Australian species. He describes both sexes of *L. caffeina*, sp. n., from a series reared from coffee in Tanganyika in 1938, and considers that the specimens obtained there from coffee in 1933 belong to this species, whereas those from *Cremnospora* do not.

Benson (R. B.). **Three Sawflies attacking Guava in Brazil (Hymenoptera Symphyta).**—*Bull. ent. Res.* **30** pt. 4 pp. 463–465, 1 fig. London, 1940.

Of three sawflies attacking guava (*Psidium guayava*) in Pernambuco, Brazil, one was identified as *Haplostegus epimelas*, Konow, and the others are described from the adults of both sexes as *Acorduleceros megacephalus*, sp. n., and *Metapedias pyensoni*, sp. n. The genus *Metapedias* is redescribed, and a list of species referable to it is given.

Pyenson (L.). **Notes on the Biology of three Tenthredinid (Hym.) Pests of the Guava.**—*Bull. ent. Res.* **30** pt. 4 pp. 467–469, 1 pl., 3 refs. London, 1940.

Brief accounts are given of the bionomics of the three sawflies that attack guava in Pernambuco [*cf.* preceding abstract]. The life-cycles of *Haplostegus epimelas*, Konow, and *Acorduleceros megacephalus*, Benson, last about a month in the rainy season, while that of *Metapedias pyensoni*, Benson, is somewhat longer. In the dry season, the full-fed larvae aestivate in the pupal cells in the soil. The eggs of *H. epimelas* are embedded in single rows in the tips of green twigs or the midribs on the lower surface of young leaves. A single leaf or twig may bear 20–40 eggs. The larvae hatch in about 3 days and feed on the leaves for 2–3 weeks. A tree may be almost entirely defoliated if several colonies of larvae are present on it. The females of *A. megacephalus* oviposit in the tips of the shoots, laying one egg in each. The larvae hatch in a few days and burrow downwards in the shoots, which finally die. A larva becomes full-fed in about 9 days, by which time it has tunnelled about 2 ins. down the shoot, and then bores to the exterior, drops to the soil, and pupates about 2–3 ins. below the surface. Injury to guava was observed from early March, at the beginning of the rainy season, until October. The eggs of *M. pyensoni* are laid singly on the upper surfaces of the older leaves. The larvae hatch in about a week and feed for about 3 weeks on the upper leaf surfaces, migrating from one leaf to another. They are difficult to detect as they cover themselves with frass. Up to 10 eggs are laid on a single leaf, but many of the larvae are killed by predators, parasites and heavy rains.

Subramaniam (T. V.). **Bionomics of a Grape Boring Plume Moth (*Oxyptilus regulus*, Meyr.) in South India.**—*Bull. ent. Res.* **30** pt. 4 pp. 471–473, 1 pl., 1 fig. London, 1940.

During the last few years, substantial damage has been caused on vines in Mysore by *Oxyptilus regulus*, Meyr., the larvae of which bore into the ripening grapes. This Pterophorid, all stages of which are very briefly described, is known to occur also in Ceylon and northern Australia. The adults are active at night and lay their eggs singly round the fruit stalks, on the peduncles and wherever the grapes in a bunch are contiguous. The larvae enter the grapes near the fruit stalks, and tunnel through the pulp to the seeds. A single larva sometimes attacks several grapes. Pupation occurs on the peduncle or on the surface of healthy grapes. In the laboratory, the egg, larval and pupal stages lasted 4–5, 12–13 and 10 days, and the adults lived for about 7 weeks. Oviposition began 18–19 days after emergence and continued for over a month.

In laboratory experiments on control, dusts of pyrethrum and wood ash applied to healthy bunches exercised a repellent effect on ovipositing females, many of which did not long survive contact with the dusts during oviposition. When they were applied to bunches bearing eggs, they killed all the resulting larvae within 24 hours of contact. They retained their toxicity for about 14 days. Oviposition occurred freely on grapes dusted with wood ash only.

SQUIRE (F. A.). **Observations on the Larval Diapause of the Pink Bollworm,** *Platyedra gossypiella,* **Saund.**—*Bull. ent. Res.* **30** pt. 4 pp. 475–481, 5 figs., 2 refs. London, 1940.

An account is given of further experiments in the West Indies on the larval diapause of *Platyedra gossypiella,* Saund., which was previously shown to be independent of seasonal or climatic conditions and caused by food of low moisture content [*R.A.E.,* A **26** 83]. It was found in St. Vincent that there was a rapid decline in the moisture content of the seed after the bolls had split, resulting in a reduction in the average percentage moisture content of the food of the larvae from 75 for those penetrating the seed 14 days before the bolls split to 29·9 for those entering 2 days before. The percentage of larvae that diapaused varied from 5·2 when the food contained 70–80 per cent. moisture to 62 when it contained 0–20 per cent. Counts on successive days showed that the percentage of immature larvae in bolls rose with an increase in the ratio of ripe to green bolls.

The other experiments were with larvae collected in Montserrat. When cotton-wool in which resting larvae had spun up was saturated with water on 11th and 29th December, pupation took place in two waves about 6–9 days after each wetting and 80 per cent. of the surviving larvae had pupated by the end of January, as compared with 3·8 per cent. in dry cotton-wool. When resting larvae in dry cotton-wool were kept for different periods at relative humidities of 90 or 60 per cent., the percentage pupating in each period was significantly greater at the higher humidity. Of 3,000 resting larvae collected between mid-October and mid-November 1937, when the temperature was 70–90°F. and the relative humidity 54–70 per cent., and kept under conditions similar to those in dilapidated ginneries, cotton houses and peasant dwellings, almost a third were still in diapause at the end of April.

The author concludes that since the survival of resting larvae in the soil and in cotton residues in the field is favoured by dry conditions, the close season for cotton should fall in wet months, where this is practicable, and that since the resting larvae are able to survive the close season in buildings, owing to the sheltered habitat, it is important that sanitary conditions should be maintained in ginneries and cotton houses as well as in peasant dwellings in which cotton is kept and sorted.

HANSON (H. S.). **Further Notes on the Ecology and Control of Pine Beetles in Great Britain.**—*Bull. ent. Res.* **30** pt. 4 pp. 483–542, 3 pls., 1 fig., 19 refs. London, 1940.

This paper comprises an account of further investigations [*cf. R.A.E.,* A **25** 643] on the ecology and control of pine beetles in Great Britain, with special reference to *Myelophilus piniperda,* L., and

M. minor, Htg. The work was undertaken to determine the reduction in value of pine crops as a result of attack by beetles, the conditions that enable the population in any particular locality to increase sufficiently to damage the crop, and the conditions that affect the development of the parasite and predator populations. Attention is directed to the need for studying the factors that govern the interaction of the pests and their natural enemies together with the ecological factors associated with the food-plant.

The following is based on the author's summary and conclusions: The results of the later experiments, which were on a much larger scale and on a wider basis, confirm those obtained in the earlier ones. It is shown that, when areas of Scots pine [*Pinus sylvestris*] are thinned, thin-barked material of small diameter can be left on the ground without risk of causing an outbreak of bark-beetles, and that this procedure, in addition to reducing expenditure, is beneficial to the crop and provides for the maintenance of a permanent population of parasites and predators. The results of thinning in summer instead of during the winter are described in detail, and it is shown that the risk of causing a bark-beetle outbreak is less when thinning is carried out during the summer, and that a longer period for dealing with the material is provided. The poles are liable to attack by *Pissodes notatus*, F., and *Hylobius abietis*, L., and should therefore be barked before the end of the following March. Experiments showed that standing trap stems could not be relied upon to give consistent results. Felled stems were much more reliable, but where trapping is considered necessary, the use of billets is to be preferred. The manner in which they should be prepared is described. Windfalls and snow-breaks are important in providing facilities for the increase of bark-beetles (particularly *M. minor* in north-eastern Scotland), and this material should be removed or barked before the broods have matured.

The results of a recent bark-beetle survey are outlined. They indicate that there has been a considerable increase in the distribution of various bark-beetles in Britain during recent years, and that certain species, formerly considered rare, have become quite abundant. Other species, of which individuals have occasionally been recorded as introduced, are now thoroughly established. Evidence is produced that *Polygraphus polygraphus*, L., attacking spruce and Scots pine, has been a pest of considerable importance for a number of years. A list is given of bark-beetles that have been imported in the bark of pit props. Thousands of these insects were found emerging from material loaded in railway trucks consigned to collieries in South Wales, and some species that have not hitherto been regarded as British were found breeding in pine crops in South Wales and the south of England. Although the importation of bark-beetles was of little importance while South Wales was destitute of coniferous forests, the position is quite different now that such forests are being developed there. Bark-beetles of the genus *Hylastes* were very numerous in many parts of Britain, and in addition to causing destruction in young plantations, they were killing pines in the pole stage and also mature trees. Examples are given of cases in which *Hylastes* and *Hylobius abietis* were killing pines 15 years old by attacking the roots for breeding purposes. *H. abietis* is considered to be the most destructive forest insect in Britain at present, and it is extremely abundant in pine areas where extensive felling is taking place, particularly in Scotland. *Pissodes notatus* was also found to be doing considerable damage in

young plantations in England, Corsican pine [*Pinus nigra* var. *calabrica*] being particularly susceptible to it. *M. piniperda* was considerably more numerous in England than in Scotland in proportion to the area of pine forest. *M. minor* appears to be extending its range and was very numerous in some parts of north-eastern Scotland.

It is considered that none of the bark-beetles need become serious pests in Britain if proper precautions are taken; examples are given of recent outbreaks, and it is shown that each outbreak was a result of mismanagement and lack of understanding of the biological principles underlying the control of insect populations. The development of bark-beetle populations is discussed, and it is shown that various factors influence the rate of reproduction of the adults, and that the density of the population steadily increases with the increase in density of the stand and also with the advance in age of the crop, until the period of maximum density is reached. The density of the population then decreases. Under normal conditions, the population is controlled at a low level of density by the combined action of temperature and humidity, parasites, predators and other factors, which are discussed in detail. Examples are given to illustrate how this control is maintained under normal forest conditions, and the importance of parasites and predators is emphasised. Further observation of *Thanasimus formicarius*, L., in the extensive pine forests of north and north-east Scotland, where it is extremely numerous and a very formidable enemy of *Myelophilus*, has shown that it is of greater value than was previously believed [**25** 644]. Owing to the facility with which the larvae can burrow, they are particularly destructive to the larvae of *M. minor*.

Abnormal conditions result in a rapid increase in the bark-beetle population, and if unchecked the beetles cause serious damage. The intensity of an outbreak depends on the amount of suitable breeding material and on the density of the initial population when facilities for increase occur. It is therefore essential to keep the population at a low level of density. Stress is laid on the importance of preventing outbreaks rather than destroying mature insects that have been allowed to develop, and measures during all stages of the development of the crop are discussed.

GOLDING (F. D.). **Notes on the Variegated Grasshopper, *Zonocerus variegatus*, L., in Nigeria.**—*Bull. ent. Res.* **30** pt. 4 pp. 543–550, 8 refs. London, 1940.

An account is given of observations on the life-cycle of *Zonocerus variegatus*, L., bred in outdoor cages at Ibadan, Nigeria, during the period 1932–37. This Acridid is widespread in Nigeria and in French West Africa [*cf. R.A.E.*, A **19** 371], and it ranges across tropical Africa through the Belgian Congo and into Uganda and Kenya. It is polyphagous and damages cotton, cassava, maize, cacao, *Cola*, cowpeas, bananas and *Citrus* in Nigeria. The hoppers are gregarious and may migrate for considerable distances, usually in an easterly direction [*cf.* **17** 352].

In the cages, *Z. variegatus* passed through one generation a year. The adults became sexually mature in March or April, when, with the onset of the rains, there was a rise in atmospheric humidity, with which maturation is apparently correlated. In the arid north, maturation was attained only when the relative humidity reached 80 per cent. at 9 a.m. and 60 per cent. at 3 p.m. Oviposition began

in April, and hatching took place in late October and November. It did not occur until the maximum shade temperature reached 86·5°F. and was apparently induced by the rise in soil temperature brought about by the increase of air temperature and the slackening of the rains. A high degree of soil humidity is essential during incubation, for eggs placed in dry soil shrivelled and failed to hatch. It appears probable that in the dry northern part of Nigeria, *Z. variegatus* can exist only in special areas, where the proximity of water keeps the eggs moist.

The adult stage was reached between late January and early March, the average time required for development of the hoppers being 104 days. In the field, hatching and the final ecdysis occurred somewhat earlier than in the cages, and there is some evidence that in Ibadan hoppers occasionally hatch in the spring, which suggests that in some cases eggs laid in one season do not hatch until the following year.

WALKER (M. G.). **Notes on the Distribution of *Cephus pygmaeus*, Linn., and of its Parasite, *Collyria calcitrator*, Grav.**—*Bull. ent. Res.* **30** pt. 4 pp. 551–573, 2 figs., 11 refs. London, 1940.

The following is substantially the author's summary : For the past six years, samples of wheat from fields near Cambridge have been collected. These samples were examined to estimate the incidence of *Cephus pygmaeus*, L., and its parasites, chiefly *Collyria calcitrator*, Grav. The present investigation is an analysis of sets of samples from different fields.

The data in their original form consisted of the numbers of stalks in square-yard samples, the numbers of *Cephus* larvae in the stalks and the approximate numbers of *Collyria* larvae in the *Cephus*. Cases of superparasitism, which is known to be common with *Collyria*, had not been recorded, but by making allowances for the material damaged in collection it was possible to make an estimate of the number of *Cephus* parasitised by *Collyria* in each sample. The samples in each field were arranged in ascending order of density of the stalks, and were then averaged to form four groups. They were also arranged in ascending order of the density of *Cephus*, and a similar process was carried out. Within the individual field, there appeared to be some correlation between the densities of the stalks and of *Cephus*, and between the densities of *Cephus* and of *Collyria*, but the process of averaging did not smooth out the irregularities sufficiently to enable laws of correlation to be formulated.

The next step was the drastic one of taking an average for all the fields together, the data for each field being weighted according to the number of samples represented. This enabled the following conclusions to be reached : Considered independently of the wheat-stalks, the density of *Collyria* larvae in the different parts of a field is on the whole in direct proportion to the density of *Cephus*. In the same way, the density of *Collyria* tends within a field to be proportional to the density of stalks. The density of *Cephus* is also greater where the density of stalks is greater, but the rate of increase in *Cephus* density falls off with the increase of stalk density. Mathematical curves that appear to represent the latter relation are given. These generalisations are only roughly true, and the data from the different fields deviate from them. The suggestion is that they represent the underlying

state that might exist but for factors that vary from place to place, such as food-plants, and from time to time, such as winds.

Cephus will attack barley, but so far the parasitism by *Collyria* of *Cephus* in barley has been found to be negligible. This and other observations suggest that the attraction to which *Collyria* reacts is not the host larvae themselves, but their habitual environment, wheat. It follows that the actions of females of *Collyria* within a wheat field may be taken as a fairly accurate example of searching at random for hosts. Data are given showing the way in which the population of the host and its principal parasite vary from year to year. It is concluded that the diversity of the biological and physical factors, and particularly the uncertainty of the latter, preclude any satisfactory analysis of the numerical inter-relations such as would be necessary to prove or disprove a mathematical theory of animal interaction.

SQUIRE (F. H.). **The Pink Bollworm (*Platyedra gossypiella* Saund.) in the West Indies.**—11 pp., 1 graph, 15 refs. Trinidad, 1939.

In this paper, the author discusses points of practical importance with respect to the infestation of cotton by *Platyedra gossypiella*, Saund., in the Lesser Antilles and Porto Rico, based on observations in 1936–39. The chief cotton-growing islands of the group are St. Vincent and Montserrat ; annual Sea Island cotton is the variety chiefly cultivated, but perennial Marie Galante is grown on Grenada and the Grenadines. Brief accounts are given of the topography of the islands and of the spread of *P. gossypiella* to all of them between 1920 [*cf. R.A.E.*, A **9** 99] and 1923.

During the flowering period, the larvae inhabit the staminal column and often penetrate the ovary, thus preventing the fruit from setting and causing the young bolls to be shed. As a result of infestation in the boll phase, the lint becomes stained and the seed is destroyed, or the whole boll may rot and drop off. Many heavily infested bolls are unable to open. The adults pair in the early morning [*cf.* **25** 631]. In observations in St. Vincent on oviposition, in which 11 pairs were selected at random, the number of eggs per female ranged from 55 to 256 and averaged 111·1. The peak of oviposition occurred on the fourth night after pairing. If egg capacity is determined by the temperature at which the pupal stage is passed [*cf.* **24** 763], conditions in the West Indies are conducive to a high uniform rate of oviposition. The eggs are laid singly or in masses on any part of the plant, a favourite site being between the calyx and the ovary. The larvae usually hatch at night or in the morning, after an incubation period of 4 days, so that they are exposed to mild conditions before entering the bolls. Penetration of the boll is not easy [*cf.* **27** 223], and many larvae perish in the attempt. In the early stages of infestation, they prefer bolls 30 36 days old, within which they pupate well before the bolls open. As the crop ages, the number of larvae and the proportion of ripe bolls increase. The larvae are thus forced to enter ripe bolls, of which the seeds have a high fat content and a low water content. This food causes them to enter a diapause [*cf.* **26** 83] for which they seal themselves up in a cotton seed or other material, frequently joining two seeds together. The pupal stage is passed inside the boll, unless conditions in it become unhealthy, when the larvae pupate in trash or on the ground, and lasts 7–10 days.

Observations have indicated that at least 33 per cent. of the resting larvae survive the close season in sheltered positions [*cf.* **28** 408]. Dilapidated ginneries with cracks in the floor and walls offer ideal conditions for them. Such buildings should have concrete walls and sound floors, and cotton seed storehouses should be built of concrete or masonry and have well-fitting doors that can be made airtight for fumigation. Infested seed should be fumigated, or, preferably, treated in a hot-air machine, which should be fitted with a recording thermograph. Outbreaks of *P. gossypiella* often occur near peasants' dwellings where seed cotton is kept during the close season. This cotton is usually the stained remnants left after sorting and is often heavily infested. The survival of the larvae in cotton residues in the field [*cf.* **27** 223] depends on ecological factors. It is considered that a close season of $3\frac{1}{2}$ months is essential if the bollworm is to be controlled in the islands, and this season should fall partly in wet months so as to terminate the diapause [*cf.* **28** 408]. September is the best month for planting cotton throughout the Lesser Antilles. It has good planting rains that are followed by a good growing period, with a suitably timed dry season. In this way the whole area can be planted within a month or two, and the main crop will be over before the bollworm can damage it. Inter-island traffic in seed cotton should be permitted only towards the end of the crop.

P. gossypiella can complete its life-cycle on a number of alternative food-plants [**28** 44], but these are unimportant when there is a $3\frac{1}{2}$ months' close season attended by a good clean up of cotton. *Gossypium trilobum* is said to be immune from infestation [*cf.* **28** 216], and the native Haitian type of cotton exhibits marked resistance [**25** 441]. About 20 parasites of the larvae have been recorded from different parts of the world, but only two occur in the Lesser Antilles. They are the Bethylid, *Perisierola nigrifemur*, Ashm., which appears late in the season, and the mite, *Pediculoides ventricosus*, Newp., which is active only in ginneries and storehouses. Three parasites, *Microbracon kirkpatricki*, Wlkn., *Pimpla* (*Exeristes*) *roborator*, F., and *Chelonus blackburni*, Cam., have been successfully colonised in Porto Rico [*cf.* **25** 413; **26** 275], but it is not known how they will react to the close season.

TUCKER (R. W. E.). **Report on the Entomological Section** [Dep. Sci. Agric. Barbados] **for the Year ending 31st March 1939.**—*Agric. J. Barbados* **8** no. 2 pp. 56–60, 2 pls. Barbados, 1939.

As a result of increased efficiency in breeding *Trichogramma minutum*, Riley, in Barbados in 1938-39, 308 millions of this parasite were released against *Diatraea saccharalis*, F., on sugar-cane. This was the highest number ever liberated in a single year [*cf.* *R.A.E.*, A **27** 660], and although control was adversely affected by abnormal rainfall culminating in an average for the Island of 8·81, 10·58, 10·42 and 28·09 ins. in August, September, October and November, respectively, determinations of field loss and the percentage of internodes infested demonstrated decreases coincident with the increased liberations. Graphs are given showing for the years 1931–39 the numbers of parasites liberated, the average percentage of joints bored for 4 varieties of cane considered separately and combined, and the total loss. They indicate that there has been a downward trend in both total loss and internode infestation resulting from increased liberations

of *Trichogramma*, although in 1935–36, 40 per cent. of the crop was changed over from the variety Ba. 11569 to B.2935, which is more susceptible to borer attack [*cf.* **26** 221].

Planters co-operated well in collecting adults of *Diaprepes abbreviatus*, L., and *Lachnosterna smithi*, Arr. [*cf.* **28** 335], 1,400,000 of the former and 6,000,000 of the latter being collected over the same period, which suggests a diminution in the numbers of *Diaprepes*. The predacious Elaterid, *Pyrophorus luminosus*, Ill., imported against *Lachnosterna*, was again observed in small numbers in the region of the original main liberations [*cf.* **27** 660], but is unlikely to become widely or permanently established.

Very little cotton was planted in 1938, but estate cotton in large adjoining fields was completely defoliated by *Alabama* (*Aletia*) *argillacea*, Hb., in a few days at the end of December, up to which time protection had been afforded by dusting with Paris green and lime [*cf.* **28** 334], though small peasant plots were not attacked. Very little infestation by *Platyedra gossypiella*, Saund., was recorded. Of the termites present in Barbados, the most important are *Calotermes* (*Cryptotermes*) *brevis*, Wlk., which infests houses and furniture, *Eutermes* (*Nasutitermes*) *costalis*, Hlmgr., which causes considerable damage to growing sugar-cane and ornamental trees, and a species of *Coptotermes* [*cf.* **27** 56] recently identified as *C. havilandi*, Hlmgr., which is present in buildings in Bridgetown, particularly in the baggage warehouse.

MARTORELL (L. F.). **Methods of Collecting and Shipping *Larra americana* Sauss., a Parasite of the Puerto Rican Mole-cricket.**—*Ann. ent. Soc. Amer.* **22** no. 4 pp. 703–712, 3 pls., 8 figs., 3 refs. Columbus, Ohio, 1939.

An account is given of the technique employed in introducing the Sphegid, *Larra americana*, Sauss., from Brazil into Porto Rico against the mole-cricket, *Scapteriscus vicinus*, Scud. [*cf. R.A.E.*, A **27** 85]. The cages in which the adult Sphegids were kept after capture and those to which they were transferred for breeding and transport are described; they contained blossoms of *Borreria verticillata* or *Hyptis capitata*, which the adults frequent in Brazil, and supplementary food (honey and water or sugar and water) supplied in various ways. A table is given showing for the period May–June 1938 the numbers of live and dead adults received in Porto Rico; the percentage that survived the journey of about 26 hours ranged from 71 to 94. A few males were included in each shipment.

DODGE (H. R.). **The Bark Beetles of Minnesota (Coleoptera : Scolytidae).**—*Tech. Bull. Minn. agric. Exp. Sta.* no. 132, 60 pp., 4 pls., 58 refs. St. Paul, Minn., 1938. [Recd. 1940.]

An introductory section of this bulletin contains a brief review of the economic importance, bionomics and control of bark-beetles, together with a key based on characters of the brood galleries to the species that occur in Minnesota. The main section comprises a systematic list of those recorded from Minnesota, or possibly occurring there, with keys, references to the literature on them and brief notes on their local distribution and food-plants and the morphology, biology and economic importance of some of them.

Shepard (H. H.). **Insects infesting stored Grain and Seeds.**—*Bull. Minn. agric. Exp. Sta.* no. 340, 30 pp., 10 figs., 38 refs. St. Paul, Minn., 1939. **Insects infesting stored Foods.**—*Op. cit.* no. 341, 42 pp., 19 figs., 1 graph, 54 refs. 1939.

These two bulletins on pests of stored products and their control in Minnesota together constitute a revision of an earlier one [*R.A.E.*, A **10** 510]. The text has been considerably rewritten, the matter brought up to date, and the number of pests dealt with increased.

Severin (H. H. P.) & Oliver (S. J.). **Delphinium Aster Yellows.**—*Phytopathology* **29** no. 9 p. 826. Lancaster, Pa., 1939.

In experiments, the virus of California aster yellows was transmitted by adults of *Thamnotettix montanus*, Van D., and *T. geminatus*, Van D., taken from naturally infected *Delphinium*, to 84·6 and 92·3 per cent., respectively, of plants of garden varieties of *Delphinium*. The recovery and transfer of the virus from naturally infected *Delphinium* to healthy celery by previously non-infective adults of *T. montanus* and *T. geminatus* was 20·8 and 4·2 per cent., respectively. All seedlings and second-year *Delphinium* plants in which the spikes had not yet developed acquired the virus from the two Jassids, and 90 per cent. of plants did so after this stage. The incubation periods in plants of these three groups averaged 19·5, 43·5 and 45 days. In the course of the work, the virus was recovered and transmitted to healthy aster or celery from 10·9 per cent. of the infected *Delphinium* plants.

McGregor (E. A.). **The specific Identity of the American Date Mite ; Description of two new Species of** *Paratetranychus*.—*Proc. ent. Soc. Wash.* **41** no. 9 pp. 247–256, 4 figs., 8 refs. Washington, D.C., 1939.

From a study of the original descriptions and large numbers of specimens of Tetranychid mites from date fruits and foliage in the Coachella and Imperial Valleys, California, the author concludes that the mite that infests dates in this region is *Paratetranychus simplex*, Banks, of which *P. heteronychus*, Ewing [*R.A.E.*, A **10** 354] is a synonym. Both sexes of this mite are described. Examination of the male genitalia showed that it is distinct from *P. viridis*, Banks, which was described from pecan in Texas. A closely allied mite that is common on grasses in southern California and Arizona, but has not been found on date palm, is described from the adults of both sexes as *P. stickneyi*, sp. n., and characters are given distinguishing it from *P. simplex*, which also occurs on grasses.

Adults of the date mite of Algeria, which was identified by M. André as *P. simplex* [**21** 181], and of the date mite of Iraq [*cf.* **17** 691 ; **24** 471] proved to be identical. They differed, however, from *P. simplex*, particularly in the genitalia and tarsal appendages of the male, and are described as *P. afrasiaticus*, sp. n.

Hadley (C. H.). **Status of the Japanese Beetle in the Older Area of Infestation.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 18–21, 3 refs. Toronto [1939].

The following is largely the author's summary : In the part of the United States longest infested by *Popillia japonica*, Newm. (40–50

miles round Philadelphia, Pa.), the early period of its maximum abundance and destructiveness was followed by a definite decline in its numbers and the injury it caused. This decline was probably the result of a number of factors, among which were the increasing effectiveness of natural agencies of control, such as parasites and pathogenic soil organisms (including the fungus, *Metarrhizium anisopliae*, Nematodes of the genus *Neoaplectana* [*R.A.E.*, A **24** 8; **27** 165], and milky diseases [**26** 324]), the normal sequence of climatic conditions favourable and unfavourable to the insect, and the adoption and continued application of improved methods of direct control. The status of *P. japonica* now appears to be approaching that of a native pest in this area. Periods of relative abundance may be expected to be followed by periods of scarcity, with varying degrees of destructiveness to vegetation. However, because of its wide range of food-plants, its reproductive capacity and its resistance to relatively unfavourable environmental conditions, it is likely that the continued exercise of control measures will be necessary on preferred food-plants to prevent economic damage.

Reeks (W. A.). **Native Insect Parasites and Predators attacking *Diprion polytomum* (Hartig) in Canada.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 25–28, 4 refs. Toronto [1939].

Identified indigenous parasites that have been reared from the spruce sawfly, *Gilpinia* (*Diprion*) *polytoma*, Htg., in Canada include a Phorid, 5 Tachinids, 8 Ichneumonids and a Pteromalid. None is of any importance in its control, since of a total of 301,142 host larvae and cocoons collected in the field during 1931–37, inclusive, only 54 produced native parasites (·018 per cent. parasitism). Predators, which include Pentatomids of the genus *Podisus* and an Elaterid, are of some importance, but do not appear to be a major factor in control.

Barclay (J. M.). **The Oviposition Habits of some of the Species of the Genus *Exenterus* parasitic on Sawfly Larvae.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 29–31, 3 figs. Toronto [1939].

Observations are recorded on the oviposition habits of six species of *Exenterus*, females of which oviposited on larvae of *Gilpinia* (*Diprion*) *polytoma*, Htg., in the laboratory. The ways in which the eggs are attached to the host larva are described, and it is shown that the six Ichneumonids can be divided into two groups according to the method of attachment.

Green (T. U.). **A Laboratory Method for the Propagation of *Microcryptus basizonus* Grav.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 32–34. Toronto (1939].

The original stock of *Microcryptus basizonus*, Grav., one of the parasites imported into Canada for use against *Gilpinia* (*Diprion*) *polytoma*, Htg., on spruce [*cf. R.A.E.*, A **25** 13, 14], was obtained from *Diprion similis*, Htg., on pine in Poland. It was successfully reared on *G. polytoma* in the laboratory in Ontario during the winter of 1937–38 and in the following season and attacked this host more readily than its original one. Under laboratory conditions, however, there was a tendency for several eggs to be deposited in one cocoon,

even when numbers of cocoons were available ; as many as 20 eggs were observed in a single cocoon, but only one larva was able to complete development. In order to minimise the resulting wastage of host cocoons and loss of parasites, a rearing technique was developed in which batches of 10 cocoons were exposed to 5 female parasites for 2 days (the normal duration of the egg stage) in small glass-topped boxes containing blotting paper, moistened sphagnum moss and raisins. The cocoons were then replaced by others, the eggs were removed from them and each egg was implanted in a fresh host cocoon, the larva in which had previously been paralysed by heat-treatment. This cocoon was slit horizontally and the egg was inserted through the slit, which was opened by exerting slight pressure at each end of the cocoon and closed by releasing it. The cocoons were placed in batches of 25 in small vials plugged with cotton-wool covered with muslin, and kept at 73°F. and a relative humidity of 80 per cent. Under these conditions, most of the adults emerged 23–28 days later and three generations were successfully reared during the season.

Observations showed that the largest numbers of eggs are deposited 8–14 days after oviposition begins, and that fewer are produced after 22 days than at the beginning of the oviposition period. Females in the breeding boxes were therefore replaced by fresh ones after three weeks, and, since they would continue to oviposit for a further 2–3 weeks, were released in the field. During the period under review, parasite mortality, which was greatest in the egg stage, averaged 41 per cent. Adults emerged from 58 per cent. of the cocoons, and the remaining 1 per cent. of the parasites had apparently entered a diapause. The adults lived for 40–50 days in the laboratory, survived a wide range of temperature, and were successfully used for breeding after being maintained at a temperature of 40°F. for over two weeks. More than 10,000 artificially reared adults were shipped and released in forest areas infested by *G. polytoma* ; hardly any of them died before release.

Finlayson (L. R.). **A Note on the Mating of** *Coelopisthia nematicida* **(Pack.) Hewitt.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 34–35. Toronto [1939].

In the course of observations in Ontario in 1935–36 on the Pteromalid, *Tritneptis klugi*, Ratz. (*Coelopisthia nematicida*, Pack.), which is sometimes an important parasite of the larch sawfly, *Pristiphora erichsoni*, Htg., and also parasitises *Gilpinia* (*Diprion*) *polytoma*, Htg. [*cf. R.A.E.*, A **25** 13], indications were obtained that inbreeding normally occurs in this species. Adults in copula were frequently observed in host cocoons opened while the parasites were emerging or shortly before they appeared. The females cut the emergence holes and escaped before the males, although the latter were the first to complete development. Females isolated from males immediately after escaping from the cocoons gave rise to progeny of both sexes, and males normally comprised about 5 per cent. of the population. The progeny of unmated females, which were obtained by segregating the sexes in the pupal stage, when they are easily distinguished, consisted entirely of males. The author concludes that the adults normally pair before leaving the host cocoon, but that although many succeeding generations probably occur in a strictly pure line, outbreeding may also occasionally take place.

MacAndrews (A. H.). **The Pine Spittle Bug (*Aphrophora parallela* Say) as a Pest of Scotch Pine Plantations.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 35–37. Toronto [1939].

Since 1886, sporadic outbreaks of *Aphrophora parallela*, Say, have been reported on pines in the United States, including two on *Pinus rigida* in Maine and Pennsylvania. Since 1930, this Cercopid has become of increasing importance as a pest in New York State, where it has been responsible for the destruction of plantations of Scots pine [*P. sylvestris*]. In an area in which all the common species of pine were grown in pure or mixed stands, some interplanted with spruce or larch, *P. sylvestris* was the only species that was destroyed or seriously injured by it [*cf. R.A.E.*, A **28** 340]. In 1933, when it was very abundant on the trees, there appeared to be very little loss in increment directly due to insect attack, but in 1937, the tips of the branches became reddish-brown, and the tops of most of the trees were affected by the autumn of 1938. On examination, *Paratetranychus ununguis*, Jac., and *Tetranychus telarius*, L., were found to be present in numbers, the former being especially abundant, following favourable weather conditions during the summer. Less damage occurred in plantations in which the mites were scarce or from which they were absent than in those in which they were numerous, and they are therefore believed to have been a contributing factor in the destruction of the trees. In stands of *P. resinosa* and *P. strobus*, injury by *A. parallela* was very slight, but the latter became discoloured and defoliated as a result of attack by *P. ununguis*.

The bionomics of *A. parallela* are briefly described [**21** 74]. The eggs are laid in the bark in late autumn and hatch in May. When full-grown, the nymphs migrate from the frothy secretion in which they live to the tips of the needles, where they moult to the adult stage in June and July. Bark on which the adults feed becomes rough and scaly, and resin collects at the point of injury.

Brown (A. W. A.). **Forest Tent Caterpillar in Ontario in 1931–1938.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 37–42, 12 figs., 3 refs. Toronto [1939].

An account is given of an outbreak of *Malacosoma disstria*, Hb., that occurred in several districts in Ontario during 1931–38 and reached its highest intensity in 1935 and 1936. Forest trees, chiefly poplar and birch, were affected, but the damage to them was of less importance than the inconvenience caused in towns by the presence of large numbers of larvae and adults. The extent and degree of the infestations in eastern and western Ontario in 1933–38 are shown on maps.

The author concludes from a study of the outbreak that, in Ontario, new infestations develop more or less simultaneously in widely separated areas, and that the outbreak moves steadily east-south-east in successive years, becoming less severe at the original centre. Peak infestation lasts for three years and is followed by a sharp decline. During this time, increasing control is exerted by *Sarcophaga aldrichi*, Parker, which was very abundant in 1937, a muscardine fungus and wilt disease, while shortage of food and late spring frosts also contribute to the collapse of the outbreak. Outbreaks are most likely to occur in extensive continuous areas of second-growth poplar and birch about 30–40 years old.

McLaine (L. S.). **Some Notes on the Gypsy Moth Eradication Campaign in New Brunswick, and the Japanese Beetle Preventive Work.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 43–45. Toronto [1939].

A brief account is given of the discovery of the gipsy moth [*Lymantria dispar*, L.] in southern Quebec in 1924 and of its subsequent eradication [*cf. R.A.E.*, A **13** 581 ; **14** 171 ; **15** 39, 380, 529]. The position continued to cause apprehension, however, as the moth was slowly migrating north-eastward in Maine and was close to the Canadian frontier in 1936. In 1937–38, small incipient infestations were discovered in two towns and at other points in south-western New Brunswick. During the summers of 1937 and 1938, burlap bands were applied to over 1,000 trees and the larvae in them were destroyed, and no further egg-clusters were observed in the rural districts. In the towns, the problem was more difficult owing to the presence of tall unpruned elms and the occurrence of egg-clusters on private property adjacent to buildings, some of which were in a bad state of repair, and it was considered that spraying operations might be required.

The Japanese beetle [*Popillia japonica*, Newm.], which has been present in New Jersey since 1916, is not known to be established in Canada. A quarantine is maintained by the United States on the movement from infested areas of products likely to harbour the beetle, but there is a risk that it may be introduced in other products or by other means, especially during the period of flight in the summer, and special precautions have therefore been taken in Canada since 1927, particularly in the Niagara Peninsula, which is considered to be very vulnerable. In 1930, instructions were issued for the examination at the port of importation of all plant products and all commodities coming directly from heavily infested areas in the United States at the time of maximum beetle flight, in addition to nursery stock and other products covered by the quarantine, and in 1934 traps were placed at a number of points [**24** 150]. More recently, ships from ports in the United States have been examined, and a number of beetles, alive and dead, were found in them ; dead beetles have also been found in freight cars and private motor-cars at several points.

Brown (A. W. A.). **The Forest Insect Survey for 1938.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 45–52, 4 maps, 3 refs. Toronto [1939].

The work of the Forest Insect Survey [*cf. R.A.E.*, A **26** 534] was extended during 1938 and now covers most of the forest areas of Canada [*cf.* **28** 25]. Tables show the data obtained in 1937 in laboratory rearings of 9 sawflies and 9 Lepidoptera, all of which attack conifers and, with one exception, emerge in spring. They include the number of individuals received, the amount of incubation needed for emergence after hibernation, expressed in day-degrees of effective heat using 50°F. as the threshold of development, the percentage survival of larvae and pupae, the percentage parasitism, and the number of species of parasites obtained, together with the sex-ratio for the sawflies and the dates in 1936 of pupation of the Lepidoptera. In general, large species need more heat for emergence than small ones.

Notes are given on the incidence during 1938 of 4 sawflies and 10 moths, and on the natural enemies of some of them, together with maps showing the extent and degree of infestation by *Gilpinia* (*Diprion*) *polytoma*, Htg., on spruce, *Pristiphora erichsoni*, Htg., on larch,

Harmologa (*Cacoecia*) *fumiferana*, Clem., on spruce in eastern Ontario and on jack pine [*Pinus banksiana*] in western Ontario and Manitoba, and *Malacosoma disstria*, Hb.

HALL (J. A.). **Further Observations on the Biology of the Apple Maggot** (*Rhagoletis pomonella* **Walsh**).—*Rep. ent. Soc. Ont.* **69** (1938) pp. 53–58, 2 refs. Toronto [1939].

Investigations on the rearing and bionomics of the apple maggot, *Rhagoletis pomonella*, Walsh [*cf. R.A.E.*, A **25** 780] were continued in Ontario in 1937 and 1938. The various types of cages used [*cf.* **26** 561] and the technique by which adults of the overwintered generation were bred from infested fruit collected soon after it had fallen are described ; the canvas roof of the insectary was removed each morning and replaced each night to ensure exposure to sunlight.

Studies on the influence of various factors on oviposition showed that diet was the most important, but light, temperature and the state of maturity of the fruit were also contributing factors ; crowded conditions are no longer considered necessary [*cf.* **25** 780]. All the females oviposited when fed on a diet of yeast, honey and raisins, with water in a separate receptacle, and 60 per cent. did so when given one of 46 per cent. water, 46 per cent. milk, 5 per cent. honey and 3 per cent. brewer's yeast, but their longevity was reduced. The percentage of females that oviposited was 50 when the brewer's yeast was replaced by royal yeast (standard milk diet) and the mixture supplied alone or with the addition of wheat germ, and considerably lower when other diets were used.

In an attempt to obtain definite fecundity records, 52 females were confined in 1937 and 1938 in separate cages, each with 2–10 males, and supplied with the most promising diets, but only 4 oviposited, the numbers of eggs laid being 1, 31, 46 and 132. When a colony of 20 females was enclosed in 1938 with 15 males, the resulting average was 57·25 eggs per female, which is probably less than the number normally produced in the field. The maximum and average longevities of 105 males were 63 and 15·5 days and of 100 females, 62 and 21·6 days. In each of the six seasons since 1933, adults were observed in the field 3–5 weeks after all those of the overwintering generation had emerged and before the first-generation adults did so in the insectary. Adults of the overwintered generation survived in the laboratory until as late as 1st November and those of the first generation until February.

The fruits of over 20 wild and cultivated plants were examined in an attempt to determine alternative food-plants, but only hawthorn (*Crataegus*) and *Cornus amomum* were naturally infested by Trypetids agreeing with the description of *R. pomonella*. In the insectary, females from naturally infested apples oviposited readily in fruits of apple, pear, plum, tomato, cherry, *Cornus amomum*, *Crataegus*, cranberry, grape-vine, gooseberry, black currant, mayapple [*Podophyllum peltatum*] and blueberry, and the larvae completed their development in the first seven. Adults from plums oviposited in apples, and adults have already been obtained from apples infested by flies from haws. Females given a choice of apples and either black currants, plums, cherries, gooseberries, blueberries or grapes oviposited in both, but with the exception of cherries, which were highly attractive, and gooseberries, apples were preferred. Females from *Cornus amomum* did not puncture or oviposit in apple. When 455 males

reared from hawthorn were caged with 230 females reared from apple, mating was observed in one instance and 8 eggs were deposited. Neither mating nor oviposition was observed when males from *Cornus*, apple and hawthorn were caged with females from apple, hawthorn and *Cornus*, respectively, and cross-breeding is considered to occur rarely, if at all, under field conditions.

During three seasons, 1,603 adults identical in coloration and markings with *R. pomonella*, but about one-third smaller, were reared from fruits of *Cornus amomum*. Specimens were submitted to A. D. Pickett, who considers that the flies from apple and hawthorn are typical *R. pomonella* [*cf.* **25** 471], and that those from *Cornus* also belong to this species, although the male claspers showed slight variation. A few of the adults reared from apples and haws were no larger than those from *Cornus*, and when the form from apple was reared in fruits of *Cornus*, the resulting adults were all smaller than usual ; it is therefore concluded that the size of the adults is determined largely by the quality and quantity of food available for the larvae. It is considered that the flies infesting apple, hawthorn and *Cornus* are derived from a single species of *Rhagoletis* in which a preference for a particular food-plant has been intensified as a result of continued breeding in that species. Furthermore, flies reared on apple and hawthorn, which are more closely related to each other than to *Cornus* and which occur more frequently in association, will exchange hosts under overcrowded conditions or if one food-plant fails. The hawthorn form is therefore considered to be a danger to apple, but there is as yet no evidence that the *Cornus* form will be.

GARLICK (W. G.). **Miscellaneous Notes on the Codling Moth.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 58–61, 1 fig., 2 refs. Toronto [1939].

In the course of studies on the bionomics of the codling moth [*Cydia pomonella*, L.] in Ontario in 1931–38, 6,000 adults were trapped in bait pails in an apple orchard. The bait was a 10 per cent. solution of molasses, and except in 1931, glass pails holding about 1 quart and exposing about 15 sq. ins. of liquid were used. Each year 20 pails were hung in trees bearing good crops, at a height of about 6 ft. from the ground and as near the outside of the tree as possible. The liquid was strained and made up to the required level each week, and the traps were examined daily. The orchard was sprayed each year against first-generation larvae. Considering the period as a whole, moths were caught on each day between 1st June and 12th September, and a few occurred daily between 14th and 21st September. There were two distinct broods, approximately equal in numbers ; the dividing date between them may be arbitrarily considered as 24th July. In a given year, there was no correlation between the sizes of the two broods or between this and weather. The size of the first brood showed an almost regular fluctuation in successive years.

Rearing experiments established that 90 per cent. of the first larvae of the first generation give rise to adults in the same season, but this percentage falls as the season advances, until in mid-August it is less than 1. Serial rearing in 1935–38 indicated a general tendency for the insects in each year to have the same number of generations as their parents in the preceding year.

Examinations of infested apples from an unsprayed orchard on 14th July and at harvest or when they fell from the trees indicated

that the percentage of larvae to enter the fruit through the calyx and through the side was 8·3 and 91·7, respectively, for the first generation, and 37 and 63, for the second. These figures are compared with those obtained by other workers, and it is concluded that there is some reason to believe that the proportion of side-entries has increased of recent years.

BEAULIEU (A.). **On the Biology of the Codling Moth in Quebec.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 61–65. Toronto [1939].

Investigations in 1937 and 1938 on the bionomics of *Cydia* (*Carpocapsa*) *pomonella*, L., on apple in Quebec established the existence of a partial second generation in the year. The data obtained in laboratory rearings and from bait-traps are summarised in comprehensive tables. In the insectary, the percentages of first-generation larvae that gave rise to adults within the same season were 49 in 1937 and 17 in 1938.

Larvae and pupae were found in corrugated paper bands on the trees between 16th July and 7th September in 1937 and 19th July and 16th September in 1938, and were kept in out-door cages. The percentages of these that completed their life-cycle within the season were 30 in 1937 and 16 in 1938. In both years, bait-traps were employed in the orchard. Adults of the overwintered generation were caught between 29th May and 31st July in 1937, with a peak on 25th June, and between 1st June and 29th July in 1938, with a peak on 5th July. First-generation adults were trapped in smaller numbers between 4th August and 2nd September, with peaks on 16th and 18th August, in 1937, and between 31st July and 11th September, with peaks on 5th and 16th August, in 1938.

VAN STEENBURGH (W. E.) & BOYCE (H. R.). **Biological Control of the Oriental Fruit Moth, *Laspeyresia molesta* Busck in Ontario.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 65–74, 21 refs. Toronto [1939].

The following is substantially the authors' summary of this review of 10 years' work on the biological control of *Cydia* (*Laspeyresia*) *molesta*, Busck, on peach in Ontario [*cf. R.A.E.*, A **25** 364, etc.]: The oriental fruit moth, which at the beginning of these investigations represented a definite threat to the future of the peach-growing industry in Ontario, has diminished in importance and now appears to be under satisfactory control. In western Ontario there was a serious outbreak as late as 1937, but in this area also the moth now shows a marked reduction.

The turning point in its numbers took place in 1930, following the introduction of the larval parasite, *Macrocentrus ancylivorus*, Rohw., and a notable increase in the activity of native parasites and predators, which reduced the population of the moth and enabled *Macrocentrus* to become proportionately more abundant. Since that time, *Macrocentrus* has represented the most important factor in the control of the moth. It has displayed marked adaptability to the climatic conditions of Ontario, and wherever it has become definitely established, its life-cycle has become synchronised with that of its host. Of the native parasites, the only one that has been of any importance is *Glypta rufiscutellaris*, Cress., which is not consistent in its yearly abundance, does not interfere with control by *Macrocentrus*, and acts

as a supplementary agent. The present status of *C. molesta* in relation to its natural enemies indicates that it has approached a condition of environmental balance. Periodic increases of the population in orchards or even in districts may occur, but in general natural enemies may be expected to hold it in check.

VAN STEENBURGH (W. E.). **A Strain of *Trichogramma semblidis* Aus. from Prince Edward County, Ontario, Canada.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 74–75, 3 refs. Toronto [1939].

A dark strain of *Trichogramma* that parasitised eggs of *Sialis infumata*, Newm., in Ontario in 1931 [*cf. R.A.E.*, A **21** 284 ; **22** 361] was found to produce a high proportion of dimorphic wingless males. This strain was considered by S. E. Flanders to be *T. semblidis*, Auriv. [*cf.* **25** 719]. In a similar strain that attacks eggs of *S. lutaria*, L., in England and was studied by G. Salt [**26** 102], males produced from field-collected eggs were all wingless, whereas those reared from eggs of Lepidoptera were all winged. Mounted specimens of the dimorphic males and normal females of the English strain sent to Ontario by Salt were found to be morphologically similar to the Canadian strain, but both types of males were obtained from naturally parasitised eggs of *S. infumata* and from experimentally parasitised Lepidopterous eggs. The percentages of males that were wingless were 98·2 when *S. infumata* was the host, and 27·2–8·8 when eggs of *Ephestia kuehniella*, Zell., *Cydia molesta*, Busck, *C. pomonella*, L., and *Pyrausta nubilalis*, Hb., were used. There was a tendency towards the production of fewer wingless males from the larger host eggs. Parasitism was incomplete in *P. nubilalis*, the eggs of which were refused by four groups of parasites. The age of the host eggs did not materially affect the percentage of the types of males reared from them.

The moisture content of the habitat is more critical in *T. semblidis* than in the other common North American species of the genus [*cf.* **25** 719]. Reduced humidity did not appear to affect the type of male produced, but when the relative humidity was much below saturation point, emergence did not take place.

THOMPSON (R. W.). **Further Notes on Corn Borer Resistance in Hybrid Corn ; with a Brief Statement of the Investigation Situation in Ontario in 1938.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 76–81, 1 ref. Toronto [1939].

Work on the resistance of various strains of maize to the European corn borer [*Pyrausta nubilalis*, Hb.] in Ontario [*R.A.E.*, A **26** 536] was continued in 1938, when 17 standard varieties and 40 hybrids were investigated at two stations. The average borer populations of the standard varieties and of the hybrids that proved suitable for cultivation in Ontario are shown in charts. In general, the resistance of some of the hybrids again compared favourably with that of the standard varieties, and the performance of some tested in the previous year was confirmed ; the percentage reduction in infestation was rather larger than in 1937, although the infestation in the district surrounding the experimental plots was smaller. Furthermore, in 34 of 39 hybrids less than 30 per cent. of the stalks were broken, whereas the percentage of injured stalks was below 30 in only 2 of the 12 standard varieties

tested. The yield and date of maturing of the hybrids that showed promise as regards resistance and strength of stalk were in most cases equivalent to those of the standard varieties.

Throughout the greater part of Ontario the degree of infestation during 1938 remained about the same as in the previous year, or decreased slightly, but it was greater in four western counties ; in two other counties in western Ontario where it was severe in 1937 there was a decrease, mainly as a result of a vigorous campaign, although the amount of moisture during the period of moth flight, oviposition and larval establishment was rather less in them than elsewhere in the same area. A table is appended showing the percentages of stalks infested in the various counties of Ontario in each of the years 1926–38.

James (H. G.). **Some Field Observations on the Biology of *Chelonus annulipes* Wesm., an Introduced Braconid Parasite of the European Corn Borer.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 82–84, 2 refs. Toronto [1939].

Field investigations on the seasonal development of *Chelonus annulipes*, Wesm., an imported parasite of the European corn borer [*Pyrausta nubilalis*, Hb.] on maize, were made in two districts in southern Ontario during 1936. In one of these, the Braconid had been liberated in 1935, and the percentage parasitism in April 1936 was 2·9 in stubble and 4·8 in débris ; in the other, which was on the shore of the lake, a colony had been maintained since 1931, without further liberations, and the percentage parasitism was 6 in stubble and 8 in débris. The types of soil and the crops grown in each district are described.

Larvae of *C. annulipes* overwintered in the first instar, in fourth-instar larvae of the host. They had begun to resume development on 5th May in both places, but in the lake-side district, where the soil was stony clay, development during the first two weeks of May was slow ; by 6th June, however, pupation had begun in both districts. Eggs of *P. nubilalis* were first observed in the field on 26th June, and adults and empty cocoons of *C. annulipes* were also present three days later. To determine whether parasitised larvae of *P. nubilalis* overwintering in stubble and débris can survive burial during clean-up operations, infested maize-stalks were buried on 5th May at a depth of 4 ins. in loam in a large cage fitted with traps to catch the larvae as they came to the surface. Parasitised and unparasitised larvae emerged from the soil over a period of about a fortnight and, except during the first 4 days, when unparasitised individuals appeared more rapidly, there was little difference in the relative rates of emergence. On 28th May, groups of 25 parasitised larvae were buried at depths of 2 and 4 ins. both in sandy loam and in stony clay. Emergence from the two soils continued over periods of 5 and 12 days, respectively ; the depth at which the larvae were buried appeared to delay but not prevent emergence. It is considered therefore that the retarded development of *C. annulipes* in the lake-side district may have been partly due to the slower emergence of the host larvae from the soil.

Eggs and larvae of *P. nubilalis* were collected in the field in July-September to determine the rate of development of the parasite in them. It was shown that eggs and first-instar larvae of the latter were present by 3rd July. The larvae were in a more advanced state of development in the lake-side district, where host eggs were available

at an earlier date, and they completed their summer development by mid-August, whereas those in the other locality continued to develop during September and appeared to overwinter at a more advanced stage in the first instar. Female parasites appeared to prefer host eggs that were 2 days old for oviposition. The difference in autumn development in the two districts studied indicates the probable influence of some unknown factor, which may be partly responsible for the localised establishment and distribution of the Braconid in America and Europe.

WISHART (G.). **Some Observations on the Effect of Temperature on the Sex Ratio of a Hymenopterous Parasite** *Chelonus annulipes* **Wesm.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 85–87, 1 ref. Toronto [1939].

When Hymenopterous parasites are reared in the laboratory, it is difficult to secure a ratio of females to males as high as that found in nature. Investigations were therefore carried out in Ontario on the factors determining the sex ratio in *Chelonus annulipes*, Wesm. Prior to 1937, this Braconid was bred on a strain of *Pyrausta nubilalis*, Hb., that produces only one generation a year, but studies on the effect of temperature were then impracticable because the host could be reared in sufficient numbers only at temperatures of 80–85°F., lower temperatures causing the larvae to diapause. When this occurs, *C. annulipes*, which does not normally pass through a resting stage, also enters a diapause. In 1937, *Ephestia kuehniella*, Zell., was used as a host. The eggs of *Ephestia* are attacked less readily than those of *Pyrausta*, and the parasites obtained from it are smaller, but it showed no tendency to diapause at the lower temperatures. When the parasitised eggs and larvae of *Ephestia* were kept at 60°F., the parasite larvae failed to reach the second instar, and this temperature is therefore considered to be below the threshold of development. The average percentages of females among parasites resulting from hosts kept at 70, 80 and 90°F. were 21·0, 12·4 and 10·7, respectively, and when the progeny of adults reared at 70 and 90°F. were kept at 80°F., the resulting percentages of females averaged 66·3 and 14·9. Since males, which develop from unfertilised eggs, were freely produced from eggs deposited by the adults reared at 90°F., it appears probable that this temperature tends to sterilise the males and not the females. On the other hand, the different sex ratios in the parasites reared at different temperatures suggest some selective elimination of females at the higher temperatures.

HAMMOND (G. H.). **White Grub Prospects in Ontario for 1939.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 87–90, 1 ref. Toronto [1939].

Previous surveys of the incidence of larvae of the genus *Lachnosterna* (*Phyllophaga*) in Quebec and Ontario have shown that all the species have a three-year life-cycle, that second-year larvae are the most injurious to crops, and that in any one year larvae in the same stage of development occur throughout south-western Quebec and eastern, central and western Ontario, despite the different number of species present in the last two sections, whereas another stage is characteristic throughout the Niagara Peninsula and southern and central Quebec [*cf. R.A.E.*, A **25** 367]. Further surveys in 1936, 1937 and 1938

confirmed these findings and are used as a basis for forecasting the prospects of white-grub incidence in Ontario during 1939.

In 1938, second-year larvae were prevalent throughout the Niagara Peninsula, where *L.* (*P.*) *rugosa*, Melsh., was responsible for the greater part of the severe injury caused to beans, maize, autumn wheat, potatoes, strawberries, pasture, meadows and lawns, and little damage was expected in 1939. Major flights of adults occurred in 1938 in five areas in Ontario, and it was expected that second-year larvae would be prevalent in these during 1939. Notes are given on the incidence of infestation in each district and on cultural measures to avoid injury to crops. The most important flights were in southern Ontario, where *L.* (*P.*) *anxia*, Lec., and *L.* (*P.*) *fusca*, Fröl., occurred in approximately equal numbers and seriously defoliated trees, and in south-western Ontario, where trees were also defoliated, chiefly by *L.* (*P.*) *futilis*, Lec. In the latter area, the association between soil type and white-grub injury, which is more severe on sandy soils than on clay or loam, is more marked than elsewhere.

Maheux (G.) & Gauthier (G.). **The most vulnerable Stage in the Life Cycle of June Beetles.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 90–93. Toronto [1939].

An account is given of investigations in Quebec in 1936–38 on the control of white grubs [*Lachnosterna*], which were causing rapidly increasing damage in the eastern districts and in the region north of Montreal. The control given by light-traps was negligible as only 12 per cent. of the adults caught were females, and although about 65 per cent. of the larvae could be destroyed by cultural measures, including ploughing and harrowing [*cf. R.A.E.*, A **23** 234] and control was facilitated by the choice of resistant crops [**23** 333], simpler methods were still required. In preliminary experiments in 1936, a high percentage of pupal mortality was obtained by ploughing and harrowing during the 3–4 weeks corresponding to the pupal period, and injured pupae that completed their development gave rise to imperfect adults in which the wings remained embryonic.

Further investigations carried out in southern Quebec in 1938 showed that it is almost impossible for a pupa to survive, even if it is uninjured, unless it has the protection afforded by the pupal cell. In the locality in question, many larvae were constructing or had completed their pupal cells on 15th June, 25 per cent. had pupated by 25th June, and 50 per cent. of the pupae had given rise to adults by 25th July. Of 9 lots of 50 pupae placed on 2nd, 15th or 28th July in cages with floors of wire screen containing about 1 in. soil, covered with about 6 ins. soil, and examined on 17th or 24th August, only 6 survived, and these were unable to complete their development. Mortality was complete on 24th August when pupae were exposed to the sun for 3, 6 or 12 hours before being buried on 3rd August. When 50 larvae that were constructing their pupal cells and 50 newly emerged adults were similarly buried on 2nd July and 3rd August, respectively, without exposure to the sun, the percentage mortalities on 24th August were 100 and 50. In field trials in which ploughing was followed by disking twice at intervals of 10–15 days, complete mortality was obtained when the plots were ploughed on 2nd or 15th July; 5 per cent. of the pupae were crushed, 85 per cent. were killed indirectly owing to the disturbance of the soil, and 10 per cent. were destroyed by disking. When

ploughing was delayed until 28th July or 3rd August, 5 and 10 per cent. of the newly-emerged adults survived ; the mortality caused by disking was greater than earlier in the season. On the basis of these experiments, it is suggested that land should be left fallow for summer ploughing against the pupae in years in which the larvae are in their third year.

HUCKETT (H. C.). **Recent Developments in Cabbage Worm Control on Long Island.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 93–96, 2 refs. Toronto [1939].

Following investigations on Long Island on the use of non-arsenical dusts for controlling *Pieris rapae*, L., *Plusia* (*Autographa*) *brassicae*, Riley, *Plutella maculipennis*, Curt., and *Ceramica* (*Mamestra*) *picta*, Harr., on cruciferous crops, the results of which have already been noticed [*R.A.E.*, A **22** 568 ; **25** 549, etc.], rotenone dusts, which were not effective against *Ceramica* or the older larvae of *Plusia* [**24** 726], were almost replaced in work on a commercial scale by dusts containing pyrethrum (0·9 and 0·6 per cent. pyrethrin content). A rise in the cost of pyrethrum, however, made their use impracticable in 1938. In the experiments, dusts containing stock powders carrying concentrated amounts of pyrethrins in solution had given promising results, though they were less effective than dusts containing the ground flowers, and during 1938 they were used locally on a large scale, with varying degrees of success. Failure is believed to be largely due to inexperience in handling this type of dust with the machinery available, but improved methods of manufacturing and preparing the dusts are also required. It is important that the ingredients should be thoroughly mixed, especially if stock powders that are greasy in consistency are used ; fine grades of clay are unsatisfactory as carriers [**25** 550] probably owing to their absorbent properties, but other carriers, such as talc, were satisfactory. Attempts were made to improve the dusting qualities by the addition of small quantities of diatomaceous earth, since some impregnated dusts were too heavy and too oily for effective use in many of the types of dusting equipment available.

Impregnated dusts are effective at lower pyrethrin concentrations (0·25 or 0·3 per cent.) than pyrethrum dusts, probably because all the particles are active and because they carry the pyrethrins on their surface. Insecticides of plant origin are not ideal for use against cabbage caterpillars, because they are not markedly toxic to chewing insects in general, they lack resistance to deterioration and they are expensive to manufacture and prepare.

BAKER (A. W.). **Notes on the Armyworm,** *Leucania unipuncta* **Haw., Outbreak in Ontario in 1938.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 96–99. Toronto [1939].

A widespread outbreak of *Cirphis* (*Leucania*) *unipuncta*, Haw., occurred during 1938 in Ontario, where this Noctuid had not been of importance since 1914 [*R.A.E.*, A **3** 18]. The areas of severe infestation were larger and more numerous than in 1914, though there were probably fewer districts in which infestation was moderate to heavy. The outbreak began earlier, and oviposition extended over a longer period ; damage was first observed on 30th June and fields in one district were still heavily infested on 8th August.

Graminaceous plants were the only ones to be attacked, but, in contrast to 1914, when most of the damage to spring grain was caused by larvae that had migrated from grasses, the most severe injury occurred where, probably as a result of the earlier outbreak, the eggs were actually laid on the spring grain. In some cases, larvae migrated to spring grain from winter wheat as the latter matured.

Egg masses were not observed in the field in autumn, but observations in the insectary and the field indicated that they are probably deposited on the crown of the plant or on or just below the surface of the soil [*cf.* **15** 664]. This Noctuid is supposed to overwinter in the larval stage, but overwintering pupae were secured in the insectary, and this may also be a result of the earliness of the outbreak. Parasites were less abundant than in 1914, although pupae of a Braconid, probably *Apanteles militaris*, Walsh, were numerous throughout the infested areas. Parasitism by the Tachinid, *Winthemia* sp., which was high in 1914, did not exceed 2–4 per cent. except in the Niagara district, and other parasites were also less numerous.

Trenches or deep furrows were used to trap the larvae that migrated, and where the furrows had to be made in heavy soil, the results were improved by scattering poisoned bait in them not later than 4 p.m. Almost complete control was obtained in a field of barley, in which a standard bait containing Paris green, bran, molasses and water was broadcast ; the field was 16 acres in extent and 700 lb. bran (dry weight) was used. Baits containing sodium arsenite or white arsenic and dusting with nicotine were unsatisfactory.

In view of the low degree of parasitism, the extensive flight of adults during late summer and autumn, and the occurrence of larvae in the autumn in at least one infested area as well as in the insectary, in all of which the 1938 outbreak differed markedly from that of 1914, a further outbreak in 1939 was considered possible.

Maheux (G.) & Lagloire (P.). **The 1939** [*i.e.* 1938] **Outbreak of the Armyworm in Quebec.**—*Rep. ent. Ont. Soc.* **69** (1938) pp. 99–101. Toronto [1939].

Cirphis (*Leucania*) *unipuncta*, Haw., is widely distributed in Quebec, although it is seldom numerous enough to cause economic damage. Local outbreaks were recorded in 1917, 1935, when considerable damage was done to vegetables in various districts on the northern shore of the St. Lawrence River, and 1937 [*R.A.E.*, A **26** 145]. In 1938, however, infestation occurred throughout the whole Province, except for a zone in the south, and was especially severe in the west and north.

Observations showed that the larvae hatch and feed on weeds and forage plants growing in low lands, swamps and ditches and on the outskirts of woods, which are normally left undisturbed and where the food supply is sufficient to maintain small colonies. When climatic conditions and a scarcity of natural enemies have favoured oviposition and hatching, this supply is exhausted by the larvae during the first two instars, and they then migrate, usually to meadows where plants similar to their normal food-plants occur. Here they are frequently overlooked until the grass is mown and they again migrate to fields of small grains, maize or vegetables. If the weather is fine, the plants may be defoliated and many of the stems destroyed within 2–3 days. Buckwheat, lucerne and clover, however, are not damaged to any

appreciable extent. The period of greatest activity lasts 2–3 weeks, according to the temperature ; the first outbreak of the year was reported on 29th June and the last on 8th August.

The control measures employed included rolling and burning, and the use of trenches, poisoned bran baits and arsenical sprays. In general, poisoned baits gave the best results, but combinations of the various methods according to local conditions were satisfactory. The damage to crops was estimated at $148,000 over 45,000 acres, the cost of control at $12,000 and the value of the crops saved at $350,000.

Caesar (L.) & Dustan (G. G.). **Control of the House Cricket.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 101–105. Toronto [1939].

In August 1937, *Gryllulus* (*Gryllus*) *domesticus*, L., was found to be breeding in numbers in the newer parts of a rubbish dump about a mile from Oshawa City, Ontario. Up to 1,000 per sq. yard were found in the dump and they migrated from it at night to the very few houses in the vicinity, causing great trouble in the nearest one, a cottage about 120 yards away. At least 2,000 dead crickets as well as living ones were seen when this cottage was inspected, and the woman in it stated that she had swept up as many every morning for several days, and that the crickets occurred everywhere and damaged clothing of all kinds, apart from being an unbearable nuisance. The outbreak was controlled by abandoning the dump, covering it with soil to a depth of about 6 ins., and fumigating the house ; the sides of the latter were covered with overlapping boards and galvanised iron sheeting was sunk into the ground and nailed to the sills to prevent reinfestation. By late September both house and dump were almost free from crickets.

At Guelph, where there was a similar but smaller outbreak, treatment with a bait containing sodium fluoride, bran, molasses and water killed many of the crickets out-of-doors, but one in which the sodium fluoride was replaced by Paris green was unsatisfactory. Out-door work was discontinued in October, when it was thought that the cold would bring the trouble to an end. When a strip of floor about 4 ins. wide round the sides of a room in an infested cellar was covered with a dust composed of a mixture of equal parts of sodium fluoride and pyrethrum powder, all the crickets were either dead or dying after three days. In another cellar, in which this mixture was laid on a newspaper spread on the floor in a ring about 1 in. wide, ½ in. deep and enclosing a space about 8 ins. in diameter, and a bait composed of bread, sweet cake and ripe apple placed in the middle of it, only 20 crickets, all either dead or dying, were observed four days later.

Later in the year, laboratory tests on crickets collected from the dump were carried out with sodium fluoride, pyrethrum powder and seven other poisons, applied either mixed with food (usually dry rolled oats), in thin layers over which the crickets were allowed to run for 1–2 minutes, in rings surrounding unpoisoned food, or in small heaps among scattered heaps of food (spot method). The percentage mortalities at the end of 1, 4 and 7 days are shown in a table. Sodium fluoride and pyrethrum both gave complete mortality by the ring and spot methods in 4 days and did not repel the crickets ; the initial action of pyrethrum was much more rapid than that of sodium fluoride. Complete mortality was also obtained when sodium fluoride was mixed

with the food, but the action was then much slower. The results from the other poisons were inconclusive.

For control, it is recommended that where an incinerator for burning garbage is not available, dumps should be inspected every 2–3 weeks, and, if infested, should be covered with soil, cinders, soot or lime to a depth of at least 6 ins., and not used until they are free from infestation. If there is no alternative dump, bulky, combustible garbage should be separated from the rest and burned daily, or different parts of the dump should be used in rotation, each for a period of 2–3 weeks, and then covered as above. As a supplementary measure, three weekly applications of a bait composed of 25 lb. bran, 1 lb. sodium fluoride, 2 quarts molasses and $2\frac{1}{2}$ gals. water can be made ; the bait remains fresh for a longer period if it is scattered below the top layer of refuse. Detailed instructions are given for killing crickets in houses by means of a mixture of equal parts of sodium fluoride and pyrethrum powder applied in a ring round dry oatmeal. A box, slightly raised on one side, should be placed over the bait and poison to protect domestic animals and provide darkness, which is attractive to the crickets.

PICKETT (A. D.). **The Mullein Leaf Bug—*Campylomma verbasci*, Meyer, as a Pest of Apple in Nova Scotia.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 105–106, 4 refs. Toronto [1939].

A serious outbreak of *Campylomma verbasci*, H.-S., occurred on apple in western Nova Scotia in 1938, when the injury it caused to the fruit resulted in some cases in losses as great as 50–90 per cent. This Capsid has previously been recorded as injurious in New York State, where it caused slight damage to pears in 1913, and in Ontario, where it caused severe damage to apples in 1919 [*R.A.E.*, A **9** 131]. In Nova Scotia, it was taken on potato in the centre of the apple-producing section in 1920 and was numerous in 1925 in apple orchards severely infested by *Lygus communis*, Knight, to which the injury caused by it was probably attributed. It has also been reported as feeding on the honey-dew of Aphids, and as predacious on *Paratetranychus pilosus*, C. & F. [**23** 702]. Its normal food-plant is *Verbascum thapsus*, which it does not appear to injure, but it has been recorded on several other plants, including sugar-beet. It has two generations a year in Nova Scotia, and second-generation nymphs were observed on evening primrose (*Oenothera* sp.) and *Stachys lanata*. First-generation adults on apple soon migrate to other plants, especially potato, of which they sometimes cause the new growth to wilt and die back.

C. verbasci showed a marked varietal preference in apple orchards, and in general attacked varieties preferred by *L. communis*. A list of eight susceptible varieties is given, but the extent to which the same ones were attacked in different orchards was not constant, and infestation was often as heavy on undamaged as on damaged apples. In preliminary trials, the treatments generally recommended for apple bugs were unsatisfactory.

GILBERT (H. A.). **An Outline of the Life History of the Hop Vine Borer, *Gortyna immanis* Guenee, with Notes on its Control.**—*Rep. ent. Soc. Ont.* **69** (1938) pp. 107–114, 4 figs., 5 refs. Toronto [1939].

Considerable injury has been caused of recent years to hops near Ottawa by *Hydroecia* (*Gortyna*) *immanis*, Gn. Records of this Noctuid

in Canada and the United States are given from the literature, and the cultivation of hops near Ottawa, which is restricted to about 125 acres, is described. Severe injury is generally restricted to hops in their first year of bearing. Many of the newly-hatched larvae enter the tips of the shoots by boring in through the side [*cf. R.A.E.*, A **7** 173] or by crawling between the leaves, and their feeding causes the shoot to become swollen and blunted. Other types of injury are caused by larvae boring in the bines, which are generally entered near the surface of the ground, feeding externally at the base of the bines below ground, and feeding on the surface of the roots or boring into them. The damage above ground is relatively unimportant, since it takes place before the final selection and tying of the bines, whereas injury to the roots weakens the plants and frequently causes them to die during the winter.

The larvae hatch from the overwintered eggs about the second week in May and bore into grass stems or the newly sprouting hop plants: if they enter the plants below ground, the early stages are passed within the upper 3 ins. of soil. When the hop flowers are forming on the lateral branches, the larvae that are in grass stems or in the aerial parts of the hop plants leave them and enter the soil, where they feed on the underground parts of the bines within 3 ins. of the surface. The bines are frequently severed, either partly or completely, at the base. Sixth-instar larvae feed at a depth of 6 ins. and pupate among the roots 3–4 ins. below the surface of the soil at the end of July or the beginning of August. The adults emerge after about a month; they are active by night and shelter by day in the grassy headlands or under piles of poles or bines left in the hop gardens. The eggs, which are deposited in groups of about 50, occur almost exclusively on green foxtail (*Setaria viridis*), but have also been observed on twitch grass [*Agropyrum repens*]; they are generally inserted between the leaf-sheath and the stem of the last internode. The number of eggs deposited by a single female averages 1,500. No other food-plants have been observed by the author, but in 1938, larvae and adults reared from maize near Montreal, to which they caused severe injury, were found to be morphologically indistinguishable from *H. immanis*.

Control can be effected by clearing the hop gardens of weeds shortly before oviposition begins, so that the eggs are deposited on the grass in the headlands, where they can be destroyed by burning or spraying with crude oil [**27** 593]. Weed eradication is difficult in new gardens, however, owing to the practice of planting hop cuttings in turned-down sods and growing potatoes or beans between the young plants, and because the removal of *A. repens*, which is common, loosens the roots of the hops and renders them more susceptible to winter killing. The difficulty could be overcome by leaving the land fallow until mid-summer, then cropping it with buckwheat and delaying the planting of hops until the following year. In view of the fact that paradichlorobenzene has been recommended for the control of the larvae on the roots [**7** 174], tests were carried out in 1938 on the effect of this fumigant on the plants, and applications at the rate of 5, 10 or 15 gm. per hill were made at depths of 1, 3 and 6 ins. Plants treated on 9th May were examined for four weeks and showed no injury, but the percentages injured a week after treatment on 6th June were 12–22 on hills that received 5 gm. and 44 on those that received 15 gm. The damage was probably due to the higher temperature at the time of the later application, or to the presence of injured plant tissue as a result

of hoeing and root-pruning immediately before the treatment. Of plants treated on both dates, the percentages injured were 50 on hills receiving 5 gm. and 100 on those receiving 10 or 15 gm. It was decided that paradichlorobenzene should not be used on hops.

MATTHEWMAN (W. G.) & DUSTAN (A. G.). **Report on a Test of Tartar Emetic as a Control for the Gladiolus Thrips.**—*Rep. ent. Soc. Ont.* **69** (1938) p. 114. Toronto [1939].

In view of the successful use of tartar emetic in sprays against the gladiolus thrips [*Taeniothrips simplex*, Morison] in the United States [*R.A.E.*, A **26** 552], tests were carried out in Ontario during 1938. Five applications of sprays containing 2 oz. tartar emetic and 8 oz. brown sugar, or 1 oz. Paris green and 1½ lb. sugar, both in 2½ gals. water, were made on heavily infested *Gladiolus* in the month directly preceding the flowering period. The percentages of control, based on the relative numbers of feeding scars on the petals and the suitability of the flower spikes for sale, were 97 and 91, respectively. The tartar emetic caused no noticeable injury to the foliage, and besides being cheaper than Paris green, it is completely soluble in water.

ANDISON (H.). **The Soft Scale** (*Coccus hesperidum*) **infesting Holly on Vancouver Island. (A preliminary Report.)**—*Proc. ent. Soc. B.C.* no. 36 pp. 3–5, 9 refs. Victoria, B.C., 1940.

The following is based on the author's summary : *Coccus hesperidum*, L., was an economic pest of English holly [*Ilex aquifolium*] in the southern part of Vancouver Island during 1938, and this appears to be the first record of its occurrence in Canada as a pest of plants grown out of doors. Infested leaves, stems and berries became covered with a sooty-mould fungus, which developed in the honeydew secreted by the scales. Holly so affected is unsightly and is not saleable. The only other plants on which the Coccid was found were sweet bay [*Laurus nobilis*] and a species of ivy (*Hedera colchica*). It appeared to have more than one generation a year. Extensive tests carried out during September and October showed that an emulsion containing 2 per cent. of an oil having a viscosity of 55 and an unsulphonatable residue of 80 per cent. in combination with nicotine sulphate (1 : 800) was not injurious to the trees and gave 95–100 per cent. control.

CURTIS (L. C.). **A Note on Insects as Disseminators of Fungus Spores.**—*Proc. ent. Soc. B.C.* no. 36 pp. 6–7. Victoria, B.C., 1940.

The débris adhering to the fore and hind wings of an example of *Melanoplus mexicanus mexicanus*, Sauss., taken at Vancouver, British Columbia, was found to consist almost entirely of the spores of fungi belonging to five genera, all of which contain species injurious to plants. Counts of the spores showed that very large numbers could be carried on a single grasshopper, and the enormous numbers of grasshoppers that may occur per square yard in intense infestations indicate the importance of the phenomenon, even if only a small proportion of the spores should prove to be pathogenic and viable.

MARTIN (H.). **The Scientific Principles of Plant Protection with special Reference to Chemical Control.**—3rd edn, Demy 8vo, x+385 pp., many refs. London, E. Arnold & Co., 1940. Price 22*s.* 6*d.*

The object of this book is to present to the mycologist and entomologist a detailed survey of the physico-chemical factors underlying modern methods of control of crop pests and to provide the chemist and physicist with a means of approach to the biological side of the work and so to promote co-operation between them. This third edition follows the plan of the second [*cf. R.A.E.*, A **24** 457], but includes discussions of the many developments that have taken place during the four intervening years. The subjects in which the greatest advances have been made include the nature and control of virus diseases, the epidemiological factors determining the degree of attack, and the application to practical conditions of results of the laboratory assessment of the qualities that determine insecticidal and fungicidal efficiency.

HILLE RIS LAMBERS (D.). **Contributions to a Monograph of the Aphididae of Europe II. The Genera** *Dactynotus* **Rafinesque, 1818;** *Staticobium* **Mordvilko, 1914;** *Macrosiphum* **Passerini, 1860;** *Masonaphis* **nov. gen.;** *Pharalis* **Leach, 1826.**—*Temminckia* **4** repr. 134 pp., 6 pls., 4 figs. Leiden, 1939.

This paper includes descriptions of the genera, subgenera and species (including the various forms), with keys to them and notes on their synonymy and bionomics. One genus and several species and subspecies are new. Characters are tabulated distinguishing the three closely allied species, *Macrosiphum cholodkovskyi*, Mordv., *M. gei*, Koch, and *M. solanifolii*, Ashm., for which the author considers *M. euphorbiae*, Thos., to be an earlier name. *M. cholodkovskyi* occurs in Europe and western Asia on *Filipendula ulmaria* (*Ulmaria palustris*), on which it lives throughout the year. *M. gei* is a European species that lives on *Geum* during the whole year and also infests Umbelliferae in summer. Patch states that *M. solanifolii* migrates from rose to several other plants in North America, and though the author did not find rose infested in Holland, he considers that it may be one of the plants on which this Aphid can deposit eggs. He gives the names of several plants on which he found it hibernating and of others on which sexual forms have been recorded, and considers that it can probably produce sexual forms and hibernate on any plant on which it can live. Viviparous females overwinter in Holland on a large number of plants in glasshouses and on stored tulip bulbs and potato tubers, and in Wales, where it is much more numerous, the author found large colonies on holly (*Ilex aquifolium*) and *Acer pseudoplatanus*. Potato, beet, *Freesia*, *Cineraria* and *Epilobium* are its usual food-plants in Holland, though the author has taken it on many other herbaceous plants.

In observations in Holland on *M. avenae*, F., which occurs on practically all species of Gramineae and many other monocotyledons and was also found in summer on *Spergula arvensis*, the author observed oviposition on winter rye and other Gramineae, and considers it possible that the apterous larvae are also able to hibernate. At the beginning of May, apterae, probably of the second generation, were found on rye; the third generation included alatae, and these often occurred in the succeeding generations until late summer,

when only apterae were found. These gave rise to both alate and apterous forms, which remained on rye, and their offspring were oviparae and alate males, respectively. Neither the gynoparae nor the males fed on the leaves of various species of *Rubus* that were offered to them. The sexual forms appear to be produced in the same way as those of a normal migratory Aphid, but migration no longer occurs and the cycle is completed on what was once the secondary host. Börner has stated that *M. avenae* migrates to grasses and cereals from rose and *Rubus*, but the author considers that this statement is due to his having confused the species with *M. rubiellum*, Theo., which overwinters on *Rubus* and to a less extent on rose. The author made observations on this species, which he considers a synonym of *M.* (*Aphis*) *fragariae*, Wlk., in Holland in 1937 and 1938. The eggs were laid on *Rubus* and hatched in the first half of March. The next generation was mature at the end of April and consisted exclusively of apterae. The following generation comprised numerous alatae and a small number of apterae. The migrants could be found on almost any plant during the spring migration period, and often produced a few larvae. Migrants were experimentally transferred to *Poa annua* in 1937 and the plants were killed in two weeks, but the author did not observe them on Gramineae in nature until June 1938, when they were numerous, mainly on *Glyceria fluitans*, which later proved to be the chief summer food-plant. The gynoparae returned to *Rubus* towards the end of September and produced larvae on the lower surfaces of the leaves. The alate males appeared when some of the oviparae were mature, in the second half of October. Migration often continued until the end of November.

Smith (K. M.) & Dennis (R. W. G.). **Some Notes on a suspected Variant of** *Solanum Virus 2* (**Potato Virus** *Y*).—*Ann. appl. Biol.* **27** no. 1 pp. 65–70, 1 pl., 3 refs. London, 1940.

An account is given of an apparent variant of *Solanum* virus 2 (potato virus Y), which differs from the type virus in its symptoms and sharply in its longevity *in vitro*. The disease was first observed in the summer of 1935 affecting a tobacco plant growing near, but out of contact with, potato plants that were being used in experiments on the natural mode of transfer of *Solanum* virus 1 (potato virus X). In tobacco plants the disease was severely necrotic and superficially much resembled that caused by *Solanum* viruses 1 and 2 in tobacco, but preliminary tests showed that it was not caused by this complex. In a series of inoculations into tobacco, a proportion of the inoculated plants developed the characteristic disease while the rest developed vein-clearing, followed by vein-banding, symptoms indistinguishable from those caused by *Solanum* virus 2 in the same variety of tobacco. Inoculations from tobacco infected with the necrotic disease into a number of solanaceous plants revealed that it was not possible to produce necrosis on any plant except tobacco. On return inoculations into tobacco, the necrotic disease was reproduced, except in the case of certain host plants from which only the vein-banding element could be recovered. When the necrotic phase was once lost in a series of inoculations on tobacco plants, it never reappeared. When examples of *Myzus persicae*, Sulz., and *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) were transferred to healthy plants from tobacco plants infected

with the necrotic disease, only the vein-banding phase was produced. It is suggested that the necrotic symptom is due to a separate virus of very unstable character.

BARNES (H. F.). **The Biology of the Chrysanthemum Midge in England.** —*Ann. appl. Biol.* **27** no. 1 pp. 71–91, 1 pl., 5 figs., 3 refs. London, 1940.

A detailed account is given of investigations carried out on the bionomics in England of the chrysanthemum midge, which the author here agrees should be known as *Diarthronomyia chrysanthemi*, Ahlberg [*cf. R.A.E.*, A **28** 298]. The important points in the biology of this Cecidomyiid and the measures recommended for its eradication have already been noticed [*loc. cit.*].

FISHER (R. C.) & TASKER (H. S.). **The Detection of Wood-boring Insects by Means of X-rays.**—*Ann. appl. Biol.* **27** no. 1 pp. 92–100, 2 pls., 1 fig., 11 refs. London, 1940.

In view of the need for finding a reliable means of detecting insects in timber or furniture in the absence of visible signs of their presence and without cutting up the materials concerned, investigations were undertaken to examine the possibilities of using X-ray photography for this purpose [*cf. R.A.E.*, A **26** 190]. After briefly discussing the somewhat limited literature on this subject, the authors give an account of the technique used and the results obtained in their experiments. They conclude that the general condition of a sample of wood can readily be determined by X-ray examination, the presence of insect tunnels and the extent of disintegration within the sample being detected with ease. In favourable cases the presence or absence of insects can be ascertained, but the sample must not be too thick and must not be severely disintegrated and powdered. The limits of thickness through which various insects can be detected cannot be stated definitely, since they depend primarily upon the state of the wood and secondarily on the stage and size of the insects and the amount of frass in the tunnels in their immediate neighbourhood. When insects can be detected, their movements can be followed by taking radiographs at successive intervals of time. The method might prove of value in laboratory studies of wood-boring insects, since the progress of development cannot usually be determined without destructive examination of the infested samples. It appears that the practical application of X-rays for the detection of wood-boring insects will be confined to timber of small dimensions, such as small articles of furniture, picture panels and frames, or plywood, and, where cost allows, for determining the effectiveness of insectide treatments applied to such material. The examination of structural timbers in buildings to detect *Xestobium rufovillosum*, DeG., is generally impracticable, since such timbers are usually of large dimensions and the beetles would not generally be located; thus a negative result would be inconclusive. The X-ray equipment most suitable for the radiography of wood is one with a high power output operating in the voltage range 10–40 kVp. A Grenz-ray tube or an X-ray tube having a very thin window is essential if kilovoltages below 20–25 are to be used.

Potter (C.) & Musgrave (A. J.). **Some preliminary Experiments with β-butoxy-β′-thiocyanodiethylether as an Industrial Insecticide.**—*Ann. appl. Biol.* **27** no. 1 pp. 110–121, 11 refs. London, 1940.

The results are given of preliminary experiments in the laboratory to determine the insecticidal action of β-butoxy β′-thiocyanodiethylether (normal butyl carbitol thiocyanate), using chiefly *Cimex lectularius*, L., but also a number of pests of stored products. The thiocyanate was tested as an atomised spray, as a vapour and as a film [*cf. R.A.E.*, B **28** 150]. Almost all the insects were susceptible in varying degrees to the thiocyanate in one form or another.

Harvey (W. C.) & Hill (H.). **Insect Pests.**—Cr. 8vo, ix+292 pp., 23 figs. London, H. K. Lewis & Co., Ltd., 1940. Price 10*s.* 6*d.*

This practical handbook on insects that infest houses in Britain, which is reviewed elsewhere [*R.A.E.*, B **28** 149], contains a chapter in which notes are given on the bionomics and control of insects that do not attack man, including ants, cockroaches, Psocids, *Gryllulus* (*Gryllus*) *domesticus*, L., *Lepisma saccharina*, L., and *Thermobia domestica*, Pack., and another that deals with the control of insects that infest grain and other stored foodstuffs.

Faes (H.). **Station fédérale d'essais viticoles et arboricoles à Lausanne et Domaine de Pully. Rapport annuel 1938.**—*Landw. Jb. Schweiz* **54** pt. 1 pp. 1–26, 7 figs. Berne, 1940.

Vine pests observed in southern Switzerland in 1938 included *Phylloxera vitifoliae*, Fitch, which continued to spread in the Valais, and *Clysiana ambiguella*, Hb., and *Polychrosis botrana*, Schiff., which occurred in insignificant numbers. *Eriosoma lanigerum*, Hsm., on apple was eliminated in the autumn by *Aphelinus mali*, Hald., in the Domaine de Pully. Against *Myzus cerasi*, F., which severely infested cherries shortly before the fruits ripened, several applications were made of sprays of soap and nicotine or rotenone, following which the trees were sprayed with water to remove any possible stain or unpleasant taste from the fruits.

Ghesquière (J.). **Contributions à l'étude des hyménoptères du Congo Belge. VI.**—*Rev. Zool. Bot. afr.* **33** fasc. 1 pp. 33–41, 7 figs., 16 refs. Brussels, 1939.

The species described include the Trichogrammatid, *Megaphragma ghesquierei*, sp.n., which was reared in the Kivu region of the Belgian Congo from the eggs of *Panchaetothrips noxius*, Priesn., on the leaves of coffee. It is apparently specific to its host and may be of considerable importance in its control. The distinguishing characters of this new species are quoted from a letter by Nowicki, to whom it is attributed and who intended to publish a full description of it. As, however, it is probable that this description, together with the original types, have been destroyed in Warsaw, the author designates neotypes and gives supplementary descriptions of the adults of both sexes.

He has been informed by Nowicki that *Sethosiella priesneri*, Kryger, described as the type of its genus [*R.A.E.*, A **20** 476], should be

referred to the genus *Megaphragma*. He agrees with this view and tabulates the characters distinguishing *M. priesneri*, *M. ghesquierei* and *M. mymaripenne*, Timb.

GHESQUIÈRE (J.). *Helopeltis* **du Kivu et de l'Ituri.**—*Rev. Zool. Bot. afr.* **33** fasc. 1 pp. 67–71. Brussels, 1939.

Of the species of *Helopeltis* that occur in the eastern region of the Belgian Congo, *H. alluaudi*, Reut., which attacks cotton, cacao, *Capsicum* and *Jatropha*, was observed in 1937 puncturing the leaves of coffee in two localities in the region. This food-plant is a new record for the Capsid. *H. bergrothi*, Reut., infests cotton, cacao, ornamental plants and leguminous cover crops in Ituri and Kivu, where it has been confused with another species, *H. orophila*, sp.n., which of recent years has increased in numbers at an alarming rate in plantations of *Cinchona* and has also been recorded from tea and *Eucalyptus*. The adults of both sexes of this species and four colour forms of it are described, and characters distinguishing it from *H. bergrothi* are given. It is suggested that *Eucalyptus* trees, cut back to induce the formation of shoots from the stumps, might be used as trap-plants in plantations of *Cinchona*. *H. labaumei*, Popp., has been recorded from Ituri and occurs in the Belgian Congo on *Aframomum*.

GHESQUIÈRE (J.). **Note rectificatrice sur l'éthologie de** *Ghesquièrinia megalamellae* **Barnes.**—*Rev. Zool. Bot. afr.* **33** fasc. 1 p. 72, 1 ref. Brussels, 1939.

In view of the statement in a recent paper [*R.A.E.*, A **28** 213] that *Ghesquierinia megalamellae*, Barnes, was taken from flowers of coffee in the Belgian Congo, the author points out that there must have been an error in the notes accompanying the material submitted by him to Barnes, as this Cecidomyiid is predacious on Coccids and in Kivu attacks a species of *Pseudococcus* that infests coffee and is related to *P. kenyae*, Le Pelley. This explains the association of *G. megalamellae* with *Schizobremia coffeae*, Barnes, in East Africa [*loc. cit.*], both being predacious on *P. kenyae*.

GHESQUIÈRE (J.). **Un capside myrmécoïde nuisible au caféier.**—*Bull. Cerc. zool. congol.* **16** fasc. 1–2 pp. (30)–(32), 2 figs., 5 refs., in *Rev. Zool. Bot. afr.* **33** fasc. 1. Brussels, 1939.

Punctures on the flower buds of coffee on an estate near Mahagi, on Lake Albert, were found to be caused by *Xenetomorpha carpenteri*, Popp. This Capsid was closely associated with *Oecophylla smaragdina*, F., nests of which were very numerous on the coffee trees. The injury was very similar to that caused by *Lygus*. In view of this association, it is considered that it would be undesirable to introduce the ant into coffee plantations against *Lygus*, as has been suggested.

GHESQUIÈRE (J.). **La teigne des crucifères au Congo Belge.**—*Bull. Cerc. zool. congol.* **16** fasc. 1–2 pp. (61)–(66), 1 fig., 19 refs., in *Rev. Zool. Bot. afr.* **33** fasc. 1. Brussels, 1939.

Plutella maculipennis, Curt., was observed in the Belgian Congo for the first time in 1924, when it was taken in the Province of Katanga. Since 1933, however, it has been recorded as a pest of cruciferous vegetables in several widely separated districts, the chief centres of

infestation being Rutshuru in the Province of Kivu and Thysville in the Province of the Lower Congo in the east, and Elisabethville in the south. It is considered that the Tineid was introduced with imported cabbages and has subsequently been distributed by the transport of infested vegetables. The author has also observed it at Nairobi, in Kenya.

The number of generations in the year depends on climate ; in the Province of Kivu the moth apparently breeds throughout the year, producing 6–11 generations, whereas in the Lower Congo, owing to more abundant rainfall, the number of generations a year does not exceed 6. Under laboratory conditions in Kivu, the egg, larval and pupal stages lasted 5–10, 15–26 and 8–18 days, respectively. The eggs, of which a female lays 100–120 in 10 days, are deposited on the lower surfaces of the leaves at the rate of 3–4 to a leaf. The larvae mine the leaves and sometimes destroy the young growth and reproductive organs of the plants. Cabbage, radish, cauliflower and cultivated *Basella* are heavily infested in some localities. If *Basella alba*, which is a common weed in the Belgian Congo, also serves as a food-plant, infestation will become difficult to control. No parasites of *Plutella* were observed.

In experiments with insecticides, 99–100 per cent. mortality of the larvae was given by derris dust (containing 1 per cent. rotenone) or Paris green mixed with wood ash (2 : 15), and wood ash was superior to talc or diatomaceous earth as a diluent. Paris green is cheaper than derris, but is dangerous to use and stains the vegetables. Almost as good results were given by a mixture (1 : 6) of pyrethrum powder (containing 1·30 per cent. pyrethrins) and wood ash or by a spray containing 1 per cent. nicotine. The pyrethrum had a more rapid action on the larvae than the derris, but did not protect the plants so long. The nicotine spray gave the vegetables an unpleasant odour. All the above insecticides should be applied four times at intervals of a week, and the rate of application of the dusts should be 22½ lb. per acre. Planting strips of white mustard as a trap-crop round fields of crucifers [*R.A.E.*, A **21** 214] is also recommended.

Work of the Entomologist.—*Rep. Dep. Agric. Gold Cst 1937–39* pp. 10–11. Accra, 1939.

No widespread or intensive outbreaks of insect pests of crops occurred in the Gold Coast in the period from April 1937 to April 1939, but the absence of a marked dry spell, which permitted cacao to flush periodically and breeding to continue uninterruptedly, led to increased infestation by *Helopeltis*, *Selenothrips* (*Heliothrips*) *rubrocinctus*, Giard, which was chiefly confined to the pods, and *Sahlbergella* spp. Damage by *Sahlbergella* was severe in the Eastern Province in February–March 1938, and a closely related Capsid was also observed attacking cacao. Of 417 adults of *Ephestia* bred from cacao from various centres, all proved to be *E. elutella*, Hb. [*cf. R.A.E.*, A **23** 593].

Loss of *Citrus* fruit through the attacks of fruit-piercing moths [*cf.* **21** 278] was exceptionally high in 1937 and severe in 1938, when *Othreis* was responsible for most of the damage and *Achaea* next in importance.

Little damage was done in 1937–38 by the migratory locust [*Locusta migratoria migratorioides*, R. & F.]. Swarms matured and laid eggs

in April and May 1938 in scattered areas throughout the Northern Territories, and hoppers were reported from five districts. The bands that were not destroyed gave rise to adults that flew north-eastwards in June, and by July the country was free from locusts. The planting of cereal crops was delayed, and little damage was reported. The swarm of the next generation flew southwards across the Gold Coast in November. No damage occurred in the northern part of the Northern Territories as all crops had been harvested. In Togoland, considerable damage was done to cereals in the line of flight. Other small swarms were reported during December and in January 1939; by March, all swarms were north of 7° 30′ N. lat.

The Woolly Aphis (*Eriosoma lanigera*).—*Mon. agric. Bull. Palestine* Nov. 1939 pp. 20–23, 3 figs. [Jerusalem] 1939.

Notes are given on the life-history of *Eriosoma lanigerum*, Hsm., which is an important pest of apple trees in Palestine, particularly in the Judean Hills. *Aphelinus mali*, Hald., has been introduced from Egypt [*R.A.E.*, A **27** 127] and has practically eliminated the Aphid in the orchards in which it was released, although its activity starts a little later in the year than that of its host. As climatic conditions are not severe in Palestine, it is doubtful whether *Eriosoma* hibernates on the roots, but should severe infestation of the roots occur, the soil round them should be fumigated with paradichlorobenzene, parasitism by *A. mali* on infested roots being very restricted.

Cherian (M. C.) & Kylasam (M. S.). **Studies on *Laphygma exigua* Hb. and its natural Enemies.**—*J. Bombay nat. Hist. Soc.* **41** no. 2 pp. 253–260, 5 refs. Bombay, 1939.

The results are recorded of an investigation carried out in 1936–37 in view of the severe damage caused by *Laphygma exigua*, Hb., to tobacco seedlings in nurseries at Chirala (Guntur district), South India [*cf. R.A.E.*, A **26** 55]. The food-plants of this Noctuid are reviewed from the literature, and the technique of tobacco cultivation in the district is briefly described. The larvae remove the mesophyll from the lower surfaces of the leaves of young seedlings and often completely destroy the first formed leaves, but cease to be a menace when the plants are about a month old. They often occurred in association with *Plusia signata*, F., and *Prodenia litura*, F., but were more numerous than these Noctuids except on tobacco cultivated by peasants. A sand-dune weed, *Gisekia pharnaceoides*, appears to be the source of primary infestation of tobacco [*cf. loc. cit.*], and as *Laphygma* apparently breeds throughout the year, it probably survives on this weed until tobacco is available. Under insectary conditions, the moths lived for up to 15 days when fed on syrup, and the females began to oviposit on the second day after emergence and usually laid about 1,300 eggs in batches of 20–200. The eggs were laid indiscriminately on tobacco and other plants and on the sides of the cages, but never on the soil. The egg, larval and pupal stages lasted about 2, 15 and 6–7 days, respectively. Most of the larvae pupated on the surface of the soil, but a few pupae occurred at depths of 2–4 ins. in cocoons made of silk and earth.

The Tachinids, *Sturmia inconspicuoides*, Baranov, and *Actia monticola*, Mall., were reared from larvae taken on *G. pharnaceoides*,

but not from those from tobacco, and the Reduviid, *Rhynocoris fuscipes*, F., which occurred in large numbers, was predacious on the larvae on tobacco. Observations on *S. inconspicuoides* in the laboratory showed that pairing takes place immediately after emergence and that usually only one egg is laid on each host larva. The apparent absence of the Tachinids from tobacco nurseries may be due to the density of the vegetation and frequent watering. In the insectary, *Trichogramma minutum*, Riley, was reared on the eggs, but parasitised only some of those in any individual batch, the others being apparently protected from it by the felt of hairs that covers the egg-mass. Females of *R. fuscipes* usually began to oviposit on the night of the fifth day after emergence. The maximum number of eggs deposited was 340; oviposition did not occur every day, and the numbers laid on any one day varied from 5 to 38. The eggs, which are described, hatched in 5–7 days, and the life-cycle was completed in 31–51 days. Adults survived for up to 90 days and destroyed 4–5 larvae of *Laphygma* in a day. In the laboratory, the bugs fed readily on *Peregrinus maidis*, Ashm., which was used for rearing them, and also accepted the larvae of several species of Lepidoptera and a weevil.

Ramakrishna Ayyar (T. V.). **A Caterpillar Pest of Champaka (*Michelia champaca*) in South Malabar District.**—*J. Bombay nat. Hist. Soc.* **41** no. 2 pp. 443–445. Bombay, 1939.

Several young champaka trees (*Michelia champaca*) on a farm in the South Malabar district of India were recently observed to be infested by the larvae of *Papilio agamemnon*, L., which was not found on any other food-plant in the region. Descriptions are given of all stages of this butterfly, which occurs all over India, especially in areas having abundant rainfall. The life-cycle lasts 4–5 weeks. The eggs are laid on the lower surfaces of the leaves, and the larvae hatch in 3–4 days, feed on the leaves and sometimes almost defoliate the branches, the attack being more common during the rainy months from June to September. The pupae are fixed by means of silk strands to the leaf stalks or branches. No other insect pests have been recorded from champaka in South India, where it is commonly grown for timber and its flowers are of market value.

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CONTENTS.

CONTENTS—*cont.*

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